"The Automobile in War" by a Rough Rider

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The Automobile Magazine

ILLUSTRATED

VOL. I NOVEMBER 1899 No. 2

The United States Industrial Publishing Company
New York City U. S. A.

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Motor Scouts in Action

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The Automobile MAGAZINE

VOL. I NOVEMBER 1899 No. 2

The Automobile in War

By Edwin Emerson, Jr.

First U. S. V. Cavalry

"Napoléon s'est moqué de Fulton et de ses bateaux à vapeur; nos gouvernants devraient tâcher d'éviter qu'on ne leur reprochât un jour d'avoir méprisé la voiture automobile."—Jean Baptiste Jobard's *Observations Recueillies*, 1835.

THE God of Battles, according to a cynical utterance of Napoleon, is apt to favor the side that musters the greatest numbers. Bismarck amended this to the effect that the God of Battles smiles upon those who manage to get there first with the greatest numbers. Admiral Dewey and Colonel Roosevelt, in the face of heavy odds, put their trust in "good guns and straight shooting," and such seems likewise to be the last article of faith with Oom Paul and his pious Boers.

England, in her present championship of modern civilization in South Africa, puts her reliance on a general superiority of force, both as to actual numbers and more effective engines of war. The sharp-shooting Boers are met by machine guns belching forth cartridges at the rate of a thousand shots a minute, and the nimble skirmishing of the Veldt rough riders is offset by the operations of a balloon corps, bicycle division, armored cars, and quick-firing automobile batteries, with an advance guard of motor scouts.

In the face of such radically different methods of warfare pitted against one another the world can foresee but one final outcome—the same which resulted when the frenzied spearsmen of the Khalifa hurled themselves upon the serried ranks of Lord Kitchener's Maxim guns and magazine rifles at Omdurman.

To military men, no matter on what side their sympathies

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may be enlisted, this *fin de siècle* campaign in a far-away corner of the earth is bound to prove of transcendental interest, with its opportunities for testing the latest important product of modern invention. Accordingly military attachés from all the armies of Europe, as well as from our own, have seized this chance to see service in South Africa.

The automobile gun which has found most favor with the British war office is the so-called "motor scout," invented by Frederick G. Simms, and first exhibited by him at Richmond. It is a motor quadricycle, fitted with a Maxim quick-firing machine gun. The frame is of stiff steel tubing, well braced together, and having a standard on the front upon which is

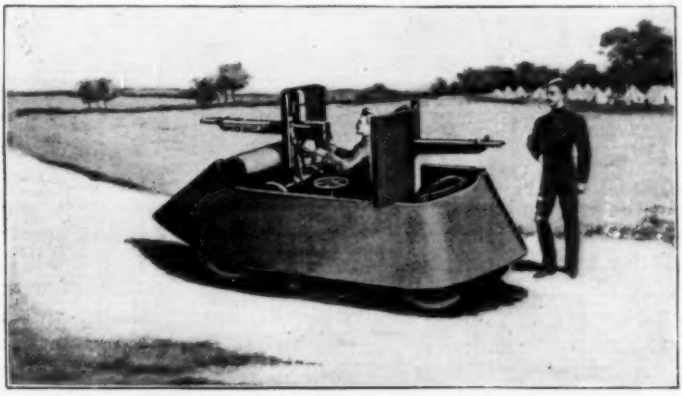
Old German Print of Cugnot's Steam Cannon (1765)

mounted the gun and a light steel shield. The ammunition is carried in boxes placed on the framing in the front. If desired, the gun can be dismounted and a seat substituted for it. A tripod mounting can also be carried if required. The wheels are made according to Messrs. Simms's design, and are fitted with pneumatic tires, the principal feature of which is the thick india-rubber tread; this is so made as to be detachable while worn, when it can be replaced by a new one. The rim of the wheel is made in three parts, the metal rim to which the rubber tire is attached, and the two side-flanges which keep the latter in place. In the case of damage, these side-flanges are easily replaced. In the event of a serious puncture, the tire collapses inside the rim, which then takes the wear. Side-flanges to the rim are shaped so as to permit a rim-brake being used with them.

The motor scout is fitted with a 1½ horse-power petroleum

motor, which can propel it at any speed up to about eighteen miles an hour for a distance of 120 miles, or further with a reserve supply of petroleum. It is convertible, carrying either two persons or one person, and a light Maxim gun. In the latter case the gun is mounted in front over the leading-wheels and so arranged that it can be fired either to the right or left or straight ahead, with the vehicle going at full speed, while in a tray below it there is room to stow 1,000 rounds of ammunition within easy reach of the rider.

Another type of " war motor car " designed by Mr. Simms, is much larger and heavier, is armor-plated all over, and has a ram both in front and behind. The armament consists of two



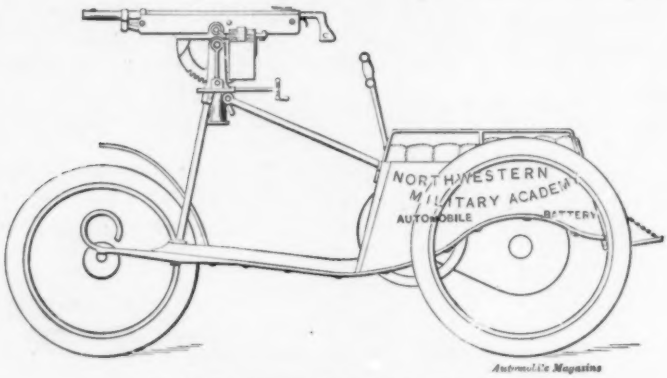
Pennington's Autoram and Battery (1899)

quick-firing Maxim guns carried in two revolving turrets. The steering is managed by means of mirrors, and it is claimed that the crew need never expose themselves outside the protection of the armor. An electric searchlight is provided, the dynamo being worked from the main engine, which is a four-cylinder Daimler motor developing sixteen horse-power nominal, and at close quarters the electrical equipment can be further utilized to give a shock to persons touching the outside of the car. The tires with which the wheels are fitted are such as will enable the vehicle to travel over very rough ground.

A third type designed by Mr. Simms is a military railway inspection car, also armor-plated, and carrying a Maxim gun.

Another similar war engine has been designed and patented by Mr. E. J. Pennington, the well-known inventor, who has made

such great strides in the autocar and motor-cycle movement. The equipment consists of two rapid-firing guns, mounted on



Major Davidson's Automobile Colt Gun

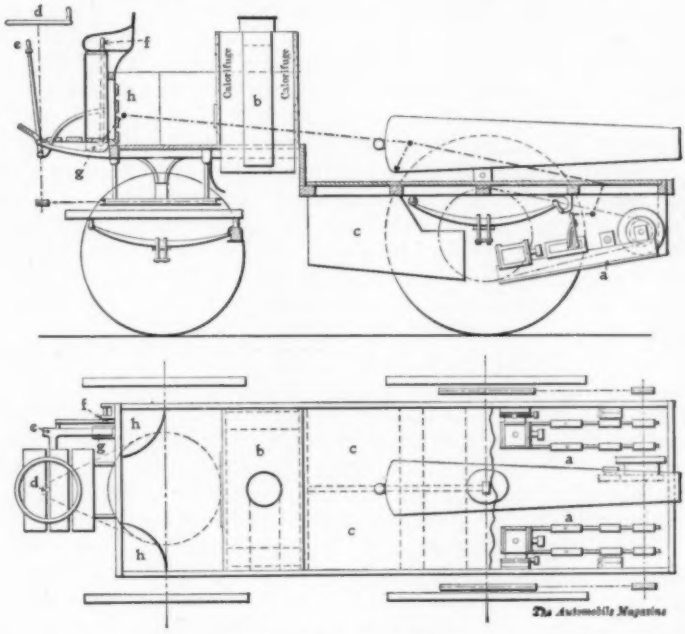
an autocar. The autocar is driven by a sixteen horse-power engine, the wheels having four-inch solid rubber tires. The guns are on a swivel, and are arranged to discharge at various angles, and they rotate automatically while they are being fired, if desired. The firing is controlled entirely by the engine which drives the autocar, and the guns may be fired while the autocar is in motion or when standing still. The ammunition is fired at the rate of from fifty to seven hundred rounds a minute. Each gun is supplied with five thousand rounds of ammunition. The shields round the autocar are arranged so that an ordinary bullet from a rifle would not penetrate, as they are on an angle, and when these machines are in motion it will be very difficult for a large field-piece to hit them.

The great trouble in the past with rapid-firing guns, according to English military authorities, has been that it is not possible to fire them at varied speeds, and sometimes the entire charge is lost owing to this fact. With a gun of the above type, it is claimed, even after the operators are shot down, the engines would continue running, and would fire the entire charge of ammunition. A rapid-firing gun is supposed to be a very good thing, provided you can come in contact with your enemy, but where you have a gun mounted on a fast-running machine, which is capable of making forty-five miles an hour, it should be an easy matter to reach close quarters. One can readily imagine what would be the effect if an appreciable number of

these engines of war were placed under one command and charged into a large body of troops.

The first constructor of automobiles for war purposes, if we leave out of account Cugnot's attempts in the direction of steam cannons during the last century, was M. Serpollet, the well-known French inventor. In 1893 he built a steam artillery and ammunition wagon, which gained the warm approval of French military authorities.

The problem set by the Ministry of War was as follows: To render self-moving a wagon of large dimensions capable of containing a load of ammunition or cannon of a weight of 3,300 pounds. With this load it was to be capable of running a distance of twenty-four miles without stopping, at a mean speed of 4.8 miles per hour, whatever be the state of the roads, gradients included. This same wagon was to be able to haul a second one in its train, loaded with 6,600 pounds of useful weight, and,



Section and Plan of Serpollet's Artillery Autocar

a, motor; *b*, generator; *c*, water tank; *d*, steering apparatus; *e*, lever of the starting pump; *f*, reversing lever; *g*, starting pump; *h*, coal bunkers; ○, swivel gun plate.

with this new charge, the speed to be, on an average, only 2.4 miles per hour, to utilize for this purpose an already existing wagon without making any change in its arrangement, the ordinary system of fore-carriage being preserved and the pole being replaced by another controlling piece.

The accompanying diagram shows the suspended artillery wagon and the arrangements of the mechanical adaptation that have converted it into a self-propelling steam wagon. The motor is placed in the rear under the floor of the vehicle. It has two cylinders and a change of direction by the Stephenson slide. The diameter of the pistons is five inches and their stroke also is five inches. The motor actuates the two driving-wheels through chains of a special system connected with the driving-wheels by an intermediate shaft with two rates of velocity. This shaft carries the differential movement.

Gradients of thirteen per cent. have been ascended with this machine without any difficulty, the wagon then having a weight of 9,460 pounds. These figures naturally lead to a comparison with traction by horses. The expense of fuel for a trip of twenty-four miles, counting coal $8 per ton, is eighty cents, adding ten cents for lubrication, it costs but ninety cents to carry 3,300 pounds to a distance of twenty-four miles. Let us compare this expense with that which would accompany eight spans of horses necessary to make the same distance in the same time, and we shall see that the first is not a third of the second. Besides, when the wagon under consideration has travelled twenty-four miles, it suffices to replenish its supply of water and fuel in order that it may immediately start on a similar journey. It would be out of the question to call upon horses to repeat such work.

The success of the tests to which M. Serpollet's invention was subjected led such progressive military men in France as General Le Marquis de Gallifet, General Zédé, and Colonel Picquart, all three of whom were supposed to be prejudiced in favor of the dashing tactics of cavalry and horse artillery, to recommend the adoption of an automobile corps to be operated in conjunction with a flying detachment of military cyclists.

Germany and Italy followed suit by introducing automobile and cycle tactics into the general field manœuvres of the last few years. At the German Kaiser manœuvres this year, it was generally commented upon as a significant thing that a military bicycle corps, supplemented by a wagon train of automobile delivery wagons, during a difficult movement over rough country, succeeded in outstripping the cavalry and in making so

decisive an onslaught upon the cavalry of the supposed enemy that the horsemen were ordered to beat a retreat.

In this country the foremost military champion of the Automobile is Adjutant-General Avery D. Andrews, of New York, the President of the Automobile Club of America, who first introduced the use of the bicycle as a police machine.

On the part of the Regular Army the utility of the automobile as a means of transporting the heavy paraphernalia of the United States Signal Corps has recently been tested under the personal supervision of General Miles. Some months ago the signal corps entered into a contract with the Fischer Equipment Company of Chicago to furnish two heavy delivery wagons and a light carriage, to be propelled by electricity from storage batteries. They were to be used in connection with the balloon service and experiments in wireless telegraphy. The heavy wagons were to be capable of carrying not less than eight hundred pounds, besides the driver, and must run for twelve miles on one charging. They may be converted into a signal corps station, and a switch-board is provided, by means of which the entire output of the battery at 55 volts may be available for general service.

These vehicles have lately been received in Washington after their efficiency had been tested at Fort Meyer. All three of the wagons are painted a pale sage-green to make them harmonize with the landscape and prevent their discovery by the enemy. The equipment of the delivery wagons is sufficient to run them thirty miles without recharging, carrying a load of 1,500 pounds. Independent motors are attached to each of the driving-wheels and are arranged to develop 6-horse-power each on grades, or 12-horse-power for the entire wagon. The average speed is ten miles an hour. All the wagons are fitted with attachments for the use of horses, and that motive power can be used at any time. The batteries in such case are taken out, leaving additional freight-room, and can then be used in connection with the field telegraph instruments, utilizing every part of the vehicles at all times. The wheels are provided with ball bearings and a rim of solid rubber makes travel smooth. Electric side lamps are on all the vehicles, and there is an electric light in the interior of the carriage. The vehicles are to be equipped with search-lights when placed in field service.

More recently still, an automobile gun-carriage constructed with a view to service in the Philippines has been thoroughly tested by Major Davidson and Sergeant Rice, of the Northwestern Military Academy.

The carriage employs the Duryea system of propulsion, which has been in use several years on carriages. It mounts a Colt automatic rapid-fire gun, firing about five hundred shots per minute. The cartridges are seven millimetre U. M. C., with smokeless powder and nickel-jacketed bullets, and have a velocity of two thousand feet per second. There is provision for carrying twenty-five hundred rounds of ammunition, a few accessories, and fuel. The large fuel tank for gasoline is placed under the forward floor, so as to be well protected from possible danger, and fuel for two hundred miles can be carried. This tank is of heavy seamless sheet-iron, and is practically bullet-proof.

The range of the gun which has a seven millimetre calibre is about two thousand yards. The gun points forward, and is ready for use at any time; it is mounted on a swivel and can be swung around, up or down, to cover any object, its sweep being that of a full half circle with a sighting range of 2,000 yards, and a firing range, when elevated, of 4,000 yards, or more than two miles.

The carriage weighs about nine hundred pounds, of which

United States Army Wagon

quantity the gun accounts for eighty. The running gear is made very strong, to withstand the rough usage to which the carriage may be subjected.

United States Signal Service Brake

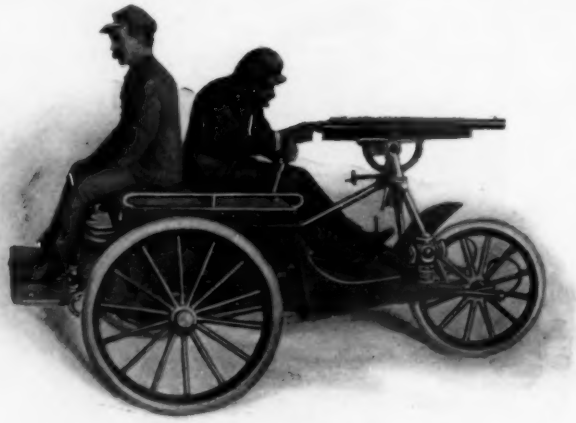
Besides this it will carry an apparatus for pulling itself out of ditches and over embankments. It consists of a windlass and tackle. It thus has the power of pulling itself up by its own boot-straps, quite a remarkable feat for a piece of artillery.

The advantages which such a cannon has are many. It can travel thirty-five miles an hour, while horses do well to cover ten miles an hour in an emergency spurt when lashed to their fullest speed. When they have travelled at this rate for two hours they usually founder and fall dead.

What an immense superiority such a piece of artillery has over the kind now in use can be imagined, when it is remembered that a horse gun carriage has to be swung completely around, stopped and unlimbered before a shot can be fired.

In the face of such startling successes some people still insist on clinging to hoary traditions of warfare dating from the days of chivalry. Thus the editor of a leading American newspaper recently expressed himself on the subject in this wise:

"The automobile may be crowding the horse, but it will be a long day before it dethrones the army mule. Representatives of the English army have been buying 1,000 mules in the



Major Davidson and His Gun

South for use in the pending Transvaal campaign. The South African problem being a stubborn one, the army mule will be right in his element there."

On the day after this was printed, appeared a despatch from Durban relating the experiences of a cattle ship sent to South Africa laden with horses and mules.

In the midst of a severe storm her steering-gear broke, and the ship fell off in the trough of the sea. Being light, she tossed about very violently, and the horses being thrown against their poorly constructed stalls, broke them down faster than they could be repaired. In a few hours all the stalls were demolished, and their splintered stanchions and side boards, with projecting spikes, were mixed up with a moving mass of the half-dead, killed, and mutilated bodies of the horses, all shifting together with every toss of the ship. Finally the whole quivering, putrifying mass settled on one side, and would have caused the ship to founder had not the crew by herculean efforts managed to throw the horses overboard, killing a few that gave trouble. All were lost.

Some time previous to this General Otis, at Manila, protested against the shipment of further horses or mules, on the

ground that they were impracticable for operations in the Philippines and cost too much for subsistence.

His protest was emphasized shortly after, a despatch announcing the loss of 300 valuable mules on the U. S. transport Siam. The ship, while nearing the end of its journey, encountered a severe typhoon. Most of the forage which was on deck was swept overboard; all the stalls for the animals were smashed, and the mules were hurled from side to side, and frightfully mangled. Their legs and necks were broken, and the wretched animals fell in such a confused mass that the attendants were unable to relieve them. All but nineteen of the animals were lost.

Such are some of the problems presented by the use of animals for war purposes. As a matter of fact, a well settled opinion

F. G. Simms on His Motor Scout

is gaining ground among the best military authorities that the horse, considered as an instrument of war, is all but obsolete.

The first power to recognize this, characteristically enough, is Japan, which has lately withdrawn all its cavalry from Formosa,

after a series of disastrous experiences in its mounted operations against the rebels in the field.

In our own war with Spain, our Government was put to the expense of more than $100,000 in purchasing cavalry horses, but a couple of hundred of which could be used for service against the enemy. Of the few horses that were used in Cuba, the majority perished under miserable circumstances, and no end of trouble was caused by their loss.

No one, surely, who ever witnessed such pathetic scenes as those pictured in Frederick Remington's famous drawing, "How the Horses Died at Santiago," would care to subject his own mount to such tortures. The suffering of the poor animals on such occasions seem the worse for serving no practical end. Thus the writer well remembers how all artillery operations came to a standstill before Santiago because the fagged-out horses could not draw the cannon over the heavy roads.

Theodore Roosevelt's experiences with the unbroken horses of the Rough Riders and his own two mounts are a case in point. After no end of trouble with the wild bronchos that were impressed into service, all had to be left behind, to be cared for through many dreary weeks and months by the unfortunate Rough Riders who had to stay behind with them. Colonel Roosevelt in his book wrote this about it:

"As it turned out, we were not used mounted at all, so that our preparations on this point came to nothing. In a way, I have always regretted this. We thought we should at least be employed as cavalry in the great campaign against Havana in the fall; and from the beginning I began to train my men in shock tactics for use against hostile cavalry. My belief was that the horse was really the weapon with which to strike the first blow. I felt that if my men could be trained to hit their adversaries with their horses, it was a matter of small amount whether, at the moment when the onset occurred, sabres, lances, or revolvers were used; while in the subsequent mêlée I believed the revolver would outclass cold steel as a weapon. But this is all guesswork, for we never had occasion to try the experiment."

Of his own two horses that were taken to Cuba, the first, named "Rain-in-the-Face," was miserably drowned while disembarking at Daiquiri; the second, "Little Texas," to be sure participated in the charge up San Juan hill, but had to drop out at the first obstruction—a barbed wire fence. All the other officers and men fought on foot.

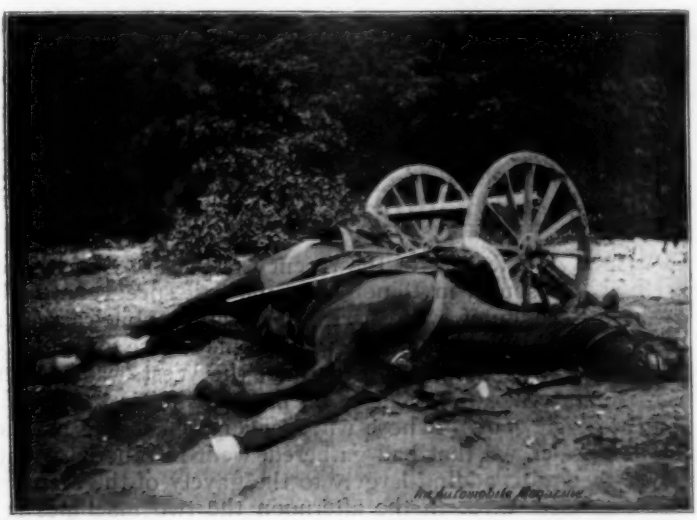
The Automobile in War

Among the general comments upon the uselessness of horses in that part of the country the writer likewise recalls how General Wheeler, cavalry leader as he was par excellence, gave it as his personal experience that cavalry attacks in modern warfare were suicidal, and should be undertaken only as " a last hope."

This coincides with Moltke's dictum after the terrible losses of the French squadrons at Wörth, Vionville, Beaumont, and Gravelotte, that the use of cavalry for general attacks could only be justified as an " ultima ratio regis."

At this latter-day stage of scientific warfare such an ultra feudal form of reasoning can no longer prevail. Any king who would send his horses against self-propelled batteries of quick firing magazine guns might as well quit the game, as did Napoleon after he had sent the flower of his cavalry into the sunken road at Waterloo.

Considered as a military machine the horse is done for.



" Done For "

(From a photograph taken at the front by the author)

"The Winner"

An American Auto Race

A UNIQUE feature of the recent Carnival of Sports held at Galesburg, in Illinois, was the first speed contest in that section of two American-built automobile carriages. The race, which was to be over a fifty mile course for a $2,000 sweepstake, widely heralded throughout the West, was run immediately after an automobile floral parade, similar to the one first held at Newport. Those who participated in the parade, and the large crowd that had gathered, went in a body to witness the race, thus adding largely to the gayety of the scene.

Shortly after three in the afternoon the two machines appeared on the track, one machine containing E. B. Snow, of Wyoming, the challenger, and an expert machinist, C. L. Turner, of Peoria. The other machine, owned by Dr. Morris, the defender, carried Albert S. Gale, of Galesburg, and Mr. Collins, an expert from Cleveland, O.

Mr. Snow's automobile was manufactured in Springfield, Mass., and was four years old, having come from the factory in

1895. It weighed 1,200 pounds. Dr. Morris's automobile came from the Winton factory at Cleveland, O., and was purchased this year. It weighed 1,500 pounds.

The judges were all from Galesburg, to wit: Col. J. T. Long, Bert Chappell, and John T. Piatt.

Before the starting of the race the following agreement was entered into by Mr. Morris and Mr. Snow, and the judges so notified: That no time would be allowed for breakages. If they could be repaired on the track, the repairs to be made, but no time for the same to be deducted. If any damage done was not repairable on the track, then the principal governing that machine was to forfeit the race.

The start was made at 3.29, and was a good one. Snow immediately took the lead and held it throughout the first mile, which was travelled in three minutes, and when the tape was crossed at the end of the first mile Snow was two carriage lengths ahead.

The second quarter of the second mile witnessed a change in the Morris machine forging ahead, and when three lengths in advance, taking the pole. The second mile was completed in 2.39, with Morris one length ahead at the crossing of the tape.

Morris maintained the lead through the third mile, which was done in 2.42, and at the completion he was one length in advance.

Snow spurted during the fourth mile, at the half, and took the lead, holding it then successfully for four miles, at varying distances. The fourth mile was done in 2.43, with Snow half a length ahead.

The fifth was completed in 2.40, and at this juncture Snow crossed the tape four lengths ahead of Morris. The five miles had been run in 13.44.

At the end of the sixth mile Snow had gained, and was now six lengths ahead, with the mile done in 2.38.

The seventh mile was made in 2.39, and the distance between the machines was the same.

In the eighth mile, when nearing the first quarter, the Morris machine made a pretty spurt, overtaking the Snow carriage and passing it. The lead here attained was never relinquished, and from that time until the completion of the race Morris retained the lead. The eighth mile was done in 2.36, with Morris three lengths ahead.

In the ninth mile Morris gained more ground, and at the completion of the mile, in 2.32, a sixteenth of a mile separated the two carriages.

The tenth mile was made in 2.45, and Morris was one-eighth of a mile in the lead at the crossing of the tape. The ten miles had been made in 26.54, the latter five in 13.10.

During the eleventh mile the Snow machine made slight gains, but this was due to Morris stopping for a can of water for the cylinder. The mile was made in 2.54, with Morris a sixteenth of a mile in advance.

It was during the twelfth mile that trouble came to the Snow machine, and when near the half-mile post it had to stop. Examination proved that one of the sparkers in the cylinder had given out, which caused the lessening of speed and which left them with but one engine to complete the race, with which it was impossible to do so.

During this time the Morris machine had been continuing its course, for Snow had not yet forfeited. The twelfth mile was made in 2.44, the thirteenth in 3.25, the fourteenth in 2.50, and the fifteenth in 3.08.

Mr. Snow had now reached the judges' stand, and forfeited the race, and the Morris machine was stopped. The fifteen miles had been done in 43.54.

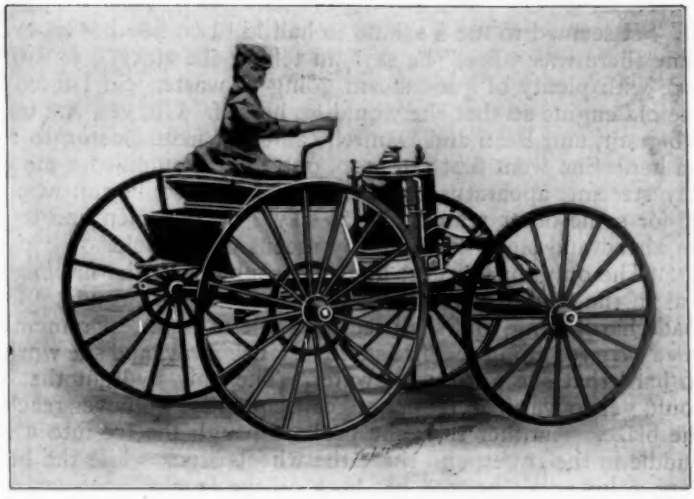
Shortly after the forfeiting of the race Mr. Snow gave authority for the announcement that he would immediately telegraph for a new Duryea machine, one of the same kind he used, and would challenge Dr. Morris for a race, to be held over the same race-track, the purse to be the gate receipts.

A NEW SPEED RECORD.

The world's record of speed for automobiles has been officially established here this week, said a Paris despatch, dated October 21st.

During the Bordeaux-Biarritz race, two weeks ago, a speed of forty miles an hour was maintained for five hours.

Yesterday, under test conditions, a representative of an automobile company averaged forty-six and one-third miles an hour during a run of six hours, without a single stop, over ordinary country roads.



Miss Betsy Carr in Control

America's First Automobile

By Lewis C. Strang

FRANK CURTIS, of Newburyport, Mass., does not claim to be the original automobilist, but he does modestly acknowledge that he was probably the first man in the New World to run an automobile. Only he does not call it by any such hifalutin name, preferring to designate it as a steam-carriage.

It was just thirty-three years ago that Mr. Curtis first showed his machine in public, to the astonishment of the citizens and the horses of Newburyport. At the same time the rash inventor incurred the openly expressed disapproval of the inhabitants of that quiet burg, who, indeed, were never brought to countenance such an uncanny thing as a wagon that went without horse-power. Mr. Curtis, indeed, was sadly in advance of his times.

This steam carriage, be it known, was not Mr. Curtis's first experience with steam-propelled vehicles. Back in the early sixties he was engineer in the local fire department, and he had charge of the first steam fire engine that the town owned.

"It seemed to me a shame to half kill two fine horses every time there was a fire," he says, in telling the story, "and that, too, with plenty of good steam going to waste. So I fixed up the old engine so that she would go herself. Oh, yes, she made a big stir, and Bean and Damrell came out from Boston to ride on her. She went first rate, too, only they wouldn't let me put any steering apparatus on her for fear she would run away—or for some other reason just as silly. So two men had to go on ahead and steer the thing by means of the pole.

"The only times I ever had any trouble with the fire engine was in the winter, when there was snow on the ground. That made hard going, and she used up a pile of water. I remember once we were going to a fire some distance away, and she worked so hard that she got out of water. The only hydrant that we could get to was frozen up, and, consequently, we never reached the blaze. Another time she broke through the ice into a big puddle in the street, and there the wheels stuck while the body kept going. We hoisted her back on the trucks, however, and went on to the fire. It was pretty late when we got there, though."

Mr. Curtis thus relates how he failed to make a fortune:

"I was the first one to use a donkey engine in the engine house to keep the steamer's boiler hot. I applied for patents for my propelling apparatus and for the heating idea. The authorities would not give me one for the propeller, but they said I could have one for the heater. That made me mad, and I made up my mind if I couldn't have a patent for the whole business, I wouldn't have one for part of it. A few years after a man offered me $20,000 for the patent on the heating idea, but, of course, I didn't have anything to sell. Then another fellow got it patented and sold it to New York City for a big price."

The steam carriage was built to order by Mr. Curtis for a Boston man—a gay Lothario, Mr. Curtis calls him. It was put together in a little shop in the old gold foundry on State Street, opposite the old Public Library, in the spring and summer of 1867, and was first used in August of that year.

"It cost me $1,000," Mr. Curtis complains, "and I never got a cent for it. The chap I made it for promised to pay half down when it was finished, and the rest if it proved satisfactory after trial. He used it a few times, but I never saw the color of his money, so I made up my mind that I had better keep it myself.

"Oh, it went all right; it was good for twenty-five miles

an hour any day in the week. I had it in running order for eleven years, and then I sold it to save my credit. The man who bought it let it go into a decline, and what is left of it is stored in a barn near my place now."

This is how Mr. Curtis thinks he saved his credit:

"You see, folks around here got to looking upon me as a sort of crank, and when I sold the steam carriage I suppose they thought I was getting sensible. At any rate, I could borrow more money after I got rid of it than I ever could before. Perhaps they only thought that I stood a better show of not getting killed, and so being able to settle up with them."

The first person to brave the dangers of an automobile ride with Mr. Curtis was a clergyman—the Rev. Dr. Seymour. The old inventor thus records his passenger's impressions:

"The parson came to me one day and asked me if I knew Betsey Carr. "'Yes, I know her,' I said; 'but she isn't Betsey Carr any longer; she's married to my uncle, Mr. Cheney.' The parson knew that, and he wanted to see her. She lived some little distance outside the town, and he didn't know how to get there.

"'I'll fix that all right,' I said. It was in the afternoon, and he had an evening service.

"'Can you get me back in time?' he asked.

"I told him I'd guarantee that, and I got out the steam carriage and we started. You never saw a man so tickled as the parson. He wanted to know if I could stop her as easily as I could steer her. So when we got to my uncle's place I ran her up between two posts and halted her as pretty as you please. Then I fetched him home and brought him up to his house with a whirl. He was immensely taken with the machine, and that evening, at the North Church service, after they had had some preliminary singing and praying, the parson got up to say something, and he talked about nothing but that steam carriage for an hour."

The following are the inventor's own specifications as verbally communicated to the writer: "She was run by a five horse-power engine. She had a vertical boiler, which weighed 109 pounds and cost $109. It was made by the Whittier Machine Works. The boiler was just in front of the back seat on which the engineer and pilot sat. She was steered by a lever, attached to the front wheels in such a way that you never felt any jolt when the wheels struck a stone or a hump in the road. The running gear was attached to the rear wheels. In front of the boiler I could rig up a dinky seat so that she would carry four persons.

The carriage and machinery weighed 618 pounds, and in a box in the rear I stowed away 80 pounds of coal. Under the seat there was a tank that contained 20 gallons of water. So the whole outfit, with four passengers, weighed over 1,100 pounds, and even then I could make 25 miles an hour.

" She never broke down with anyone except myself, and that was when I tried some experiments; and she never got stalled except once, on Plum Island sands, and she would have gone through them with the proper kind of wheels. There were no macadamized roads in those days, and she'd climb hills and never turn a hair, though you could hear her puff half a mile away. She had a blast like a locomotive, with a vent under the seat. That, of course, made a noise, and the last thing I did for the machine was to have a ' quieter ' made, but I never put it on. I carried 40 to 45 pounds of steam, usually, and she'd blow off at 80 pounds. Going up a hill she would run up to the limit in a minute and a half. Going down hill she'd fall off below normal.

" With 80 pounds of coal the steam carriage would run about 30 miles, so she wasn't particularly economical. We had to stop for water every six or eight miles, though, and that was a nuisance. The longest stretch I ever ran without stopping was nine miles, and I did it in 26 minutes. Another time, when a man kept the fire going for me, I did six miles in 18 minutes. I used to wear gloves and put the coal in with my hands. The fire-box came just where the door could be opened with the toe. I remember once I came down a hill and along a road parallel to the railroad track. A train was going the same way we were, and we made as good time as it did. The passengers opened the windows and waved their handkerchiefs and cheered us.

" The only real trouble I ever had was with horses, but even then it all depended on the driver. If he wasn't afraid, nine times out of ten the horse wasn't either. Once I was out and I met two ladies in a carriage. I turned out on the side of the road and waited for them to pass.

" ' Why did you do that? ' asked the one that was holding the lines. ' We wanted to see you go.'

" ' All right,' I said, ' if your horse doesn't mind,' and off I went. Then I came back and circled around them, just to show off a bit. I never ran over but one person, and that was a boy who persisted in trying to get across the road in front of me. I went over his ankle, but a stick of candy fixed him all right. He's living yet.

"It was the horses that finally drove me off the streets, though," Mr. Curtis added. "A wealthy woman in town had a coachman who was frightened to death of me, and he made so much talk that the woman finally complained to the Selectmen. They sent the sheriff after me, with order to keep me off the streets, or else bring me and the carriage into court. I was in the steam carriage down in Market Square when the sheriff drove up.

"'I want you,' he shouted.

"'What for?' I asked. He went on to tell me, and I suggested that he'd better read his warrant. So he sat in his carriage and I in mine while he read it. When he got to the part about delivering me over to the court, I just pulled open the throttle, and away I went, with the sheriff driving like mad after me. He might as well have been on foot. He couldn't keep anywhere near me. I ran over to the next town, and stored the steam carriage in a barn until the excitement wore away. Then I brought her home and sold her."

ELECTRIC CABS IN GERMANY.

According to the *Elektrische Zeitung*, electricity seems to be the only available power for public automobile cabs in Germany, as the use of explosive motors is forbidden by the authorities. As the cabs must have certain measurements, prescribed by the authorities, old carriages formerly used with horses were changed into electric cabs, the Hellmann and Vollmer-Kuhlstein systems being used. In Berlin the two motors are placed under the seat of the driver; each weighs 110 pounds and drives one of the rear wheels by means of a chain and a flexible shaft. Each motor alone can drive the cab at reduced speed. At 85 volts the speed is 1,100 revolutions per minute, each thus giving two horsepower. The accumulators are placed under the cab in a special case, which can be replaced by a new one in two or three minutes. The battery of four cells has a capacity of 60 to 70 ampère-hours and is sufficient for a trip of 19 to 26 miles. The braking can be accomplished electrically as well as mechanically. The cab has a weight of 2,750 pounds without passengers; it will seat five persons besides the driver. In Hamburg, one motor, known as a Vorspann, is placed under the driver's seat, and thus the front body of the vehicle cab serves to propel the rest of the transformed cab.

The Oldest Chauffeuse

By Suzette

MRS. SARAH TERRY, of Philadelphia, having arrived at years of discretion—she has celebrated her one hundred and eighth birthday—the other day went out to see the town in an automobile. The ride was a mutual pleasure and surprise all around, for the town seemed as much in-

Mrs. Terry Takes an Outing

terested in Mrs. Sarah Terry as Mrs. Sarah Terry was in the town.

This remarkable old lady in her old age has had but two desires, one of which has now been fulfilled. One is to receive a pension from the government because she is a daughter of the Revolution in fact as well as in name, and the other was to ride in an automobile.

To celebrate the event of her one hundred and eighth birthday she was taken out in a hansom belonging to the Pennsylvania Electric Vehicle Company, of Philadelphia.

The old lady was in a flutter of excitement all the morning before her prospective ride. She insisted upon dressing and being arrayed in her best bonnet and choicest shawl at least two hours before the vehicle was ordered.

The neighbors came to their doors and windows, and the passers-by paused on the pavement to see the extraordinary spectacle of an old lady, one hundred and eight years of age, walk unassisted down a long flight of marble steps and get airily into an automobile.

In spite of her years Mrs. Terry is a very charming woman, retaining the dainty manners of the last century that made her a favorite at the Danish court many years ago. Her face is framed in snow-white hair, which she wears in the quaint puffs of our great-grandmothers. There is always handsome black lace in the neck and sleeves of her gown, and her black bonnet ties in a broad bow under her chin.

The driver of the automobile took unusual interest in his passenger, and started slowly that she might not be startled.

"Doesn't it seem queer!" exclaimed the old lady, in high glee, as the automobile rolled noiselessly over the paved streets. Something of the old-time sparkle came into her eyes, and she grew animated in the bracing fall air.

When the automobile swung swiftly around a corner she opened her eyes a little wider and clung to the seat, but she gave no evidences of fear.

Once on Broad Street, the wide boulevard which is the city's pride, the quaint little figure in the horseless carriage attracted endless attention. Busy men stopped to look, people driving in their carriages stared in open-eyed amazement, the policemen grinned, and "all the town wondered."

The wind blew the old lady's bonnet strings till they fluttered out behind, but she sat up like a major, enjoying the novelty to the fullest extent. The faster the automobile went the better she liked it. The evident amazement of other old ladies she passed afforded her the greatest amusement.

"I rode in about the first steam-cars that were used," she said, "and I thought they were wonderful; but I never dreamed of riding in anything like this. Just fancy, no horses, no nothing; it all seems like magic. I should think the horses would be very jealous to see their occupation being taken from them in this fashion. When I was young, the only horseless carriages we knew were sedan chairs. It's so exhilarating, I don't see why people use horses when they can go like this. I am not nearly so uneasy as behind a skittish pair of horses."

The old lady was very anxious about her bonnet.

"I must keep it on straight, for I don't want to look rakish," she said, coquettishly.

She insisted upon the automobile stopping in front of the houses of her friends that they might see her, and so she went from one end of the city to the other, commenting brightly upon the changes that had been wrought within her recollection.

She was out two hours, and could scarcely be persuaded to go home.

"I am not a bit tired," she insisted; "it did not shake me up as ordinary driving does, and I do not see why I cannot stay out the rest of the afternoon."

In spite of her protestations she was somewhat flustered from the excitement, but she thanked the driver for the care he had shown and said it was one of the nicest birthdays she had ever had.

"And next year, when I am one hundred and nine," said the old lady, cheerfully, "I am going out again."

GROWTH OF THE NEW INDUSTRY

There are now over 7,000 owners of automobiles in Europe, and the number of vehicles is, perhaps, 10,000, and of this number, says the Annuaire Générale de l'Automobile, 5,606 are in France. There are 619 manufacturers in France, not including the makers of parts; 998 dealers in them, and 1,095 repair shops. For the remainder of Europe the figures are not very complete. There are 268 owners of automobiles in Germany, 90 in Austro-Hungary, 90 in Belgium, 44 in Spain, 304 in Great Britain, 111 in Italy, 68 in Holland, 114 in Switzerland. It is impossible to state at the present time how many automobiles are in this country, since so many new concerns are preparing to turn out motor carriages of all kinds in large quantities.

How to Buy an Automobile

By H. de Graffigny, C.E.

SO numerous are the types of motor carriages now in common use, that one who has but a superficial knowledge of mechanics hardly knows which form to select for his own purposes. For this reason I shall endeavor clearly to state those considerations which should govern the unmechanical layman in the choice of an automobile.

The use to which the vehicle is to be put is a question of paramount importance. It should be clearly determined beforehand whether the carriage is to be employed for long-distance traveling or for pleasure-riding within the limits of a city. In the former instance a petroleum-motor carriage will prove the most serviceable; while in the latter the electric carriage will answer all requirements, since at the end of each day it can be returned to its charging-station.

This first point having been disposed of, the next question to be considered is the price to be paid; and here a few remarks will not be out of place.

As in all industries which are still in their infancy, the hand-labor required in the building of automobiles is exceedingly costly. Good workmen are still difficult to obtain. Often the engineers are themselves compelled to assemble the various parts; for in this kind of work it is not a mere question of mounting an ordinary motor or building a common carriage. The one must be modified to conform with the requirements of the other. It is for this reason that the prominent manufacturers exact such high prices for their carriages; and since automobiles are rather fashionable, they receive orders for a year in advance. In spite of the prevailing high prices it is better to purchase a carriage from one of the large makers, since the more insignificant builders, not having the facilities of their better-equipped rivals, can make only inferior vehicles, and are thereby enabled to sell at low prices.

The automobile-industry at present is in very much the same state as was the bicycle-industry in 1889. At that time a good wheel was worth $150. Now a bicycle, better constructed and more durable, can be bought for one-third the money. The prospective automobile-buyer should therefore confine himself only to well-known firms, and should not hesitate to pay $200

or $300 more for a carriage that will perform all the services which he may exact of it.

When the amateur visits the various shops and compares different models, he should not allow himself to be influenced by the exterior of the carriage or by the more or less happy arrangement of parts; for external appearance has nothing to do with mechanical construction, and can be made to suit the taste of the purchaser. What is of greater moment is the motor and co-acting mechanism. The motor constitutes the essential part of the carriage; everything else is merely of secondary importance. The purchaser should carefully examine the carriage which he has in mind and ascertain whether its motor and power-transmitting mechanism are good and adapted to the needs of the carriage, whether the framework is strong and capable of yielding to strains and shocks, and whether the controlling and steering mechanisms are easily operated. The prime consideration, as I have already stated, is a good motor, simple in construction and operation—one, the parts of which are readily accessible and which is easily controlled.

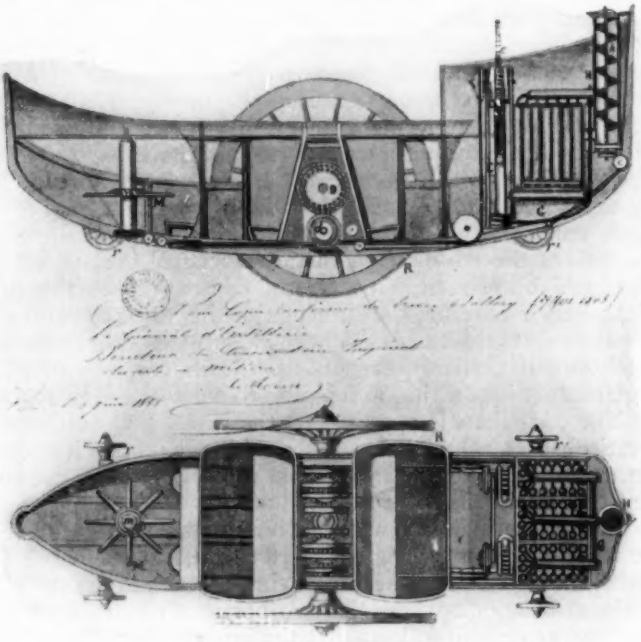
The "voiturettes," or lighter carriages, of which there are several kinds, have the advantage of being cheaper than the larger automobiles. They are extremely serviceable, not only in cities, but also in long-distance traveling and touring. They are, however, not so comfortable; and, the motor being less powerful, their speed is not so high.

Motocycles of the de Dion, Gladiator, and Clément type have been hailed with delight by many wheelmen. In starting and in ascending steep grades the motocycle must be driven by the feet as well as by the motor—a feature which is considered a fault by some and an admirable quality by the majority. The few rare opponents of this system claimed that they would prefer to ride an ordinary bicycle; but the motocyclists reply that a wheel is always fatiguing and an automobile enervating, while the motocycle combines the merits of both, in so far as it requires an amount of exercise which can be varied at pleasure.

By reason of its small height from the ground the motocycle, like the light automobile or "voiturette," is not the most pleasant of vehicles in rainy weather or on muddy roads. Unless his wheels be provided with guards, the cyclist will soon be covered with mud; and on slippery pavements he may even meet with accidents. These are the disadvantages of the motocycle compared with its advantages. As to steam motocycles, they present so many inconveniences that they are hardly to be recommended for general use.

A Floating Steam-Carriage

ON March 29, 1809, Charles Dallery filed an application in France for a patent on a steam-carriage. The patent was issued on October 2d, numbered 6,776, and entitled *Système mobile pecfectionné appliqué aux transports par terre et par mer* (An improved motive system applied to land and water transportation). The patent describes an unsubmergible boat and a carriage, both driven by the same means. We shall concern ourselves only with the carriage.



Dallery's "Boat on Wheels"

In his very obscure description of his invention Dallery states: "The carriage has the form of a boat, from the centre of which rises a casing divided into two equal portions by two back-boards (*dossiers*) separated by a space of eighteen inches."

"The carriage is traversed by an axle divided into two equal parts, each extremity of which is provided with a wheel (R) of

the ordinary size; the axle is carried by a movable frame which breaks the force of shocks received."

" The fire-engine (*machine à feu*) has in the present form but three furnaces; its proportions correspond with the size and weight of the carriage. The furnaces are located toward the rear end of the boat (G), at a distance from the casing sufficient to provide room for the man who attends to the fire."

[The smoke escapes through a stack H, the draft being produced by a screw *h*, driven by the motor.]

" Two steam-cylinders (CC′) have pistons provided with two racks (*cc′*) which turn two cog-wheels (*ee′*). The shafts of these two wheels transmit their movement by means of two ropes to two ratchets secured on a shaft (*d*), which is held by the frame. The two ratchets transmit the movement by means of a pawl (*cliquet*) having two wheels secured to the said shaft. These wheels transmit the movement to two drums (D), the said drums turning about the centre of each portion of the axle."

" Up to this point the movement has not been communicated to the axle; in order to attain this end, other intermediary means must be employed. Each portion of the axle, toward one side of the hub of the wheels (R), carries a vertical gear-wheel, the teeth of which are turned toward the centre. From this point to that of their reunion, the bearings of the axle are round; at this latter point and on each inner side are two other movable, double-toothed vertical gear-wheels, the inner teeth of which engage a cog-wheel acting as a pinion to connect the two wheels (R). The cog-wheel is operated by the wheel (M) mounted on the vertical shaft (*m*), and serves as a point of support; it operates to turn the wheels (R) parallel with each other or in a curved line, so that one turns more rapidly than the other."

" The drums inclose a wheel which meshes with the teeth of the wheel fixed on the shaft, toward the hub of the wheels (R), and with the outer teeth of each moving wheel, also mounted on the axle, at the point where the two portions meet. By reason of this engagement, it follows that the impulse is communicated to the opposite vertical gear-wheels in order to drive the wheels (R) forming part of the respective portions of the axle.

Four small wheels (*r* and *r′*) maintained the stability of the vehicle when running on up or down grades.

From this obscure description of Dallery's it is evident that a vehicle mounted on two large wheels, with small supporting wheels at the ends of the vehicle, is no new idea, although such contrivances have been patented in our own day.

The First Motor Ride

By John Grand Carteret

SIR GOLDSWORTH GURNEY, the well-known English inventor, early in the century, succeeded in perfecting a motor carriage, run by steam, to the point of exciting serious attention and comment. Even the *Britannic Review*, in one of its issues of 1829, acknowledged a discreet possibility in the new idea, in the following measured terms:

"This carriage, now perfected in all its parts, has been examined by a large number of enlightened persons. It has been put in movement in their presence. The simplicity of construction, its rapidity, the facility with which it is guided, and, above all, the evident security, have all been noted. The result of this experiment has convinced the most incredulous that the new invention will obtain the favor of the public; and that the application of the principle on which the vehicle rests will soon extend to all sorts of carriages, and thus become a universal usage."

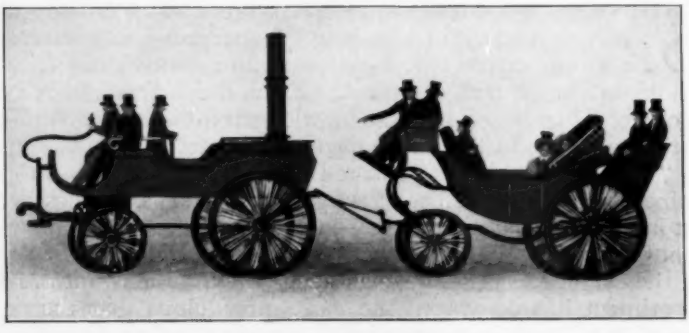
But in 1830 the same *Review* questioned in less general terms the particular difficulties of the scheme. "The great obstacle to the introduction of steam carriages was the weight of the machinery and the resistance opposed thereto by the inequalities in the surface of roadways. Our best roads present a resistance to the progress of these vehicles, because at each rise in the ground a double or triple expenditure of force is necessary to preserve headway. We should have machines of great energy which do not create a resistance equal to their weight. . . ."

An account of a ride in the Gurney stage coach was published by *The United Service Journal* (1829). The impressions of one of those who took part in this unique journey are set down as one might who made his first voyage in an air-ship or submarine boat at the present time. Here is the thrilling story:

"We numbered four in a coach attached to the steam carriage, and we had travelled without experiencing any difficulty

or mishap as far as Longford, where they were repairing the bridge built over the Cambria.

"On this bridge was a large pile of bricks, so high as to conceal what was happening on the other side. Precisely at the moment we began to cross the bridge the mail-coach from Bath arrived at a brisk trot on the other end. As soon as we perceived it we shouted to the driver to take care; but, as he was not aware of the extraordinary vehicle he was going to meet, he paid no attention to our warning and did not slacken speed. To avoid a collision, Mr. Gurney guided our steam carriage into the pile of bricks. Some damage to our apparatus resulted, but was repaired in less than a quarter of an hour. As to the horses



Old English Print

of the coach, they had taken the bit between their teeth and had to be cut loose.

"When we entered Reading it was 8.20, and we remained two hours to repair one of our wheels. Mr. Gurney had noticed that a certain small chain of the action was broken; this accident was, without doubt, the result of what had happened on the bridge at Longford.

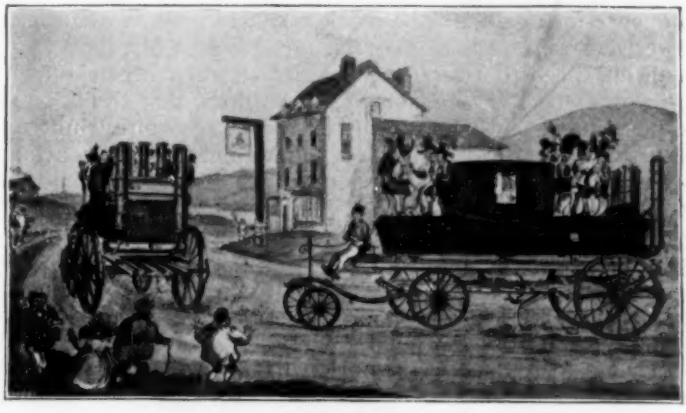
"We left Reading only at 10.30, and arrived at Melksham toward eight o'clock in the evening. We had made about six miles an hour, including stops.

"It must be remembered that our principal object had been to avoid mishap; and to that end we had provided in advance an abundant water supply. In order to incur no risk, we had made a rule to run no more than four miles without taking water. Thus we stopped whenever we noticed water facilities on the route, often when we had made but two or three miles, in the fear of missing it farther on. We were altogether eight travel-

lers, and as many engineers and workmen, for we were followed by a wagon which carried our fuel.

" No smoke was visible when we burned coke, though coal, which otherwise made a good fire, gave it out in a large amount. At Devizes the coke which we procured proved to be of so bad a quality that we were obliged to use coal. Smoke began to pour out, and, as night was falling on our arrival at Melksham, bright sparks were seen flying from the smokestack. We were agreed that these sparks might be of danger along the way if we should meet a load of straw or a hay-wagon, but we were able to avoid danger by returning to the use of coke.

" Upon our arrival at Melksham, we found that there was a fair in progress, and the streets were full of people. Mr. Gur-



Old English Print

ney, who combines with his inventive genius the most amiable qualities of heart, made the carriages travel as slowly as possible, in order to injure no one. Unfortunately, in that town the lower classes are strongly opposed to the new method of transportation. Excited by the postilions, who imagined that the adoption of Mr. Gurney's steam carriage would compromise their means of livelihood, the multitude that encumbered the streets arose against us, heaped us with insults, and attacked us with stones. The chief engineer and another man were seriously injured in the head. Mr. Gurney feared we could not pursue our journey, as two of his best mechanics had need of surgical aid. He turned the carriage into the court of a brewer named Ales, and during the night it was guarded by constables with the authori-

zation of magistrates. The next day we resumed the journey to Bath under escort.

" In Mr. Gurney's opinion, the machine was in better condition and made more headway on our return journey, which is proved by the fact that we made it in four hours' less time. The nearer we approached to the end of our journey, the more rapid became our speed. The road was, however, exceedingly muddy from a heavy rainfall."

A few notes taken on the return journey show us to what subterfuges the inventor was driven to avoid a recurrence of the disagreeable events of the first day:

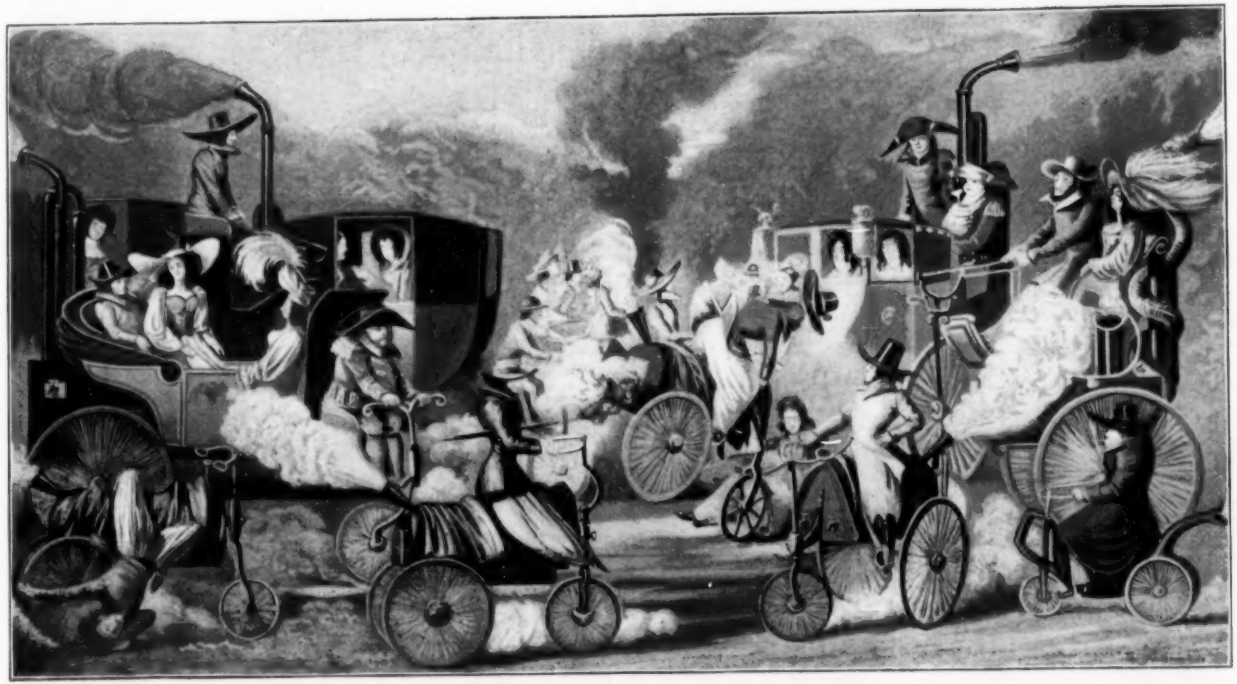
" We were six miles from Devizes at three o'clock in the morning. . . . Mr. Gurney had passed through the town of Melksham in the night with horses, so as to give the roughs no excuse for rioting. The machinery was set to work as soon as we were well on the outskirts. At Devizes Mr. Gurney put on all his speed to escape the popular aggression of the manufacturing districts. Our course was so rapid that the horses of the post carriage which accompanied us were quite winded.

" At the foot of the hill of Devizes we met the mail-coach and another carriage, which stopped to see us ascend the steep height. We mounted rapidly. The travellers in the coach, delighted at the unusual spectacle, encouraged us with shouts of applause."

To have assisted at the experiment of Gurney's steam carriage was, in those days, almost a title to glory. These carriages became speedily one of the curiosities of London. Foreign travellers who crossed the Channel and printed accounts of their journeys, did not fail to devote a chapter to the new means of locomotion. Jean Baptiste Jobard, Belgian savant and economist, was of the number, and so were Mr. Cuchetet, St. Germain Leduc, and C. G. Simon, three prominent scientific writers of that time.

M. Jobard's impressions, as noted down at the time, are worthy of record:

" My first visit in England was to the starting station of Sir Goldsworth Gurney's steam omnibus, which, during the last fortnight, has been running between London and Bath. This carriage, which can accommodate thirteen persons, does not differ materially from other stage-coaches, nor has it had any serious mishap as yet. For my benefit it manœuvred back and forth over the street pavement and later on the smooth macadam of the highway, without any apparent difficulties of guiding. The drivers of other stage-coaches are agreed that the



The Progress of Science—Whitechapel Road in 1830.

(Caricature of Aiken, published in "Modern Philosophy," in 1828.)

thing is a success, and that before long it will do them much harm. After the coach had ceased running for the day, the engineer, Mr. Gordon, showed me the mechanism in detail. When he showed the engine and boiler I saw that they had been injured by the excessive heat of the fire and that the front wheels had suffered so much from the same cause that it was necessary to make repairs.

"A common reproach against these carriages is that they frighten horses, but a parliamentary inquiry has proved that this reproach is not well founded and that most accidents were due to the carelessness of the coachmen. A curious thing is that the Society for the Prevention of Cruelty to Animals has espoused the cause of this new system of locomotion, for the purpose, so it is said, of protecting horses against the great strain that has been put upon them by the increased speed demanded from the stage-coaches of to-day."

The concluding words of this author are as effective to-day as they were then:

"Napoleon made fun of Fulton and his steam-ships. Our present rulers would do well to avoid falling into a similar contempt of the modern steam-carriage."

Steel Tubing for Automobiles

By Charles G. Canfield

SCIENTIFICALLY, seamless cold-drawn steel tubing is the best known form in which a given amount of like material can be used to resist the greatest torsion or support the maximum weight. Just when, in the world's history, this important fact was discovered and used is difficult to ascertain. It is sufficient to state that the tube is the best form of strength to resist torsion and bending.

Observe the universal appearance of the tube in vegetable life, and the most familiar example is the growth of the straws of grain. What a marvel of power to resist torsion and bending is the rye straw, which frequently rises five feet above the ground and supports the head of grain four or six inches in length and twenty-five times its weight. The bamboo of India is another example of vegetable fibre formed in a tube, of such

strength and lightness that it is common to a thousand uses in the arts. Every one of those trees is a tube; in some the body and limbs are solid, but the form is tubular; and in many tropical species the trunks are hollow.

In animal life the same thing appears. The bones of most animals are round, excepting where strength is sacrificed to form. The ribs that contain the vitals in the chest inclosure are made strong by being formed of flattened tubes. This is a mere economy of space. Even the vertebræ of the fishes are tubular, and the form is so common in animal life that there is no need of specifying.

Passing from the study of the tube in nature, the most wonderful example of its manipulation and adaptation by man is the bicycle. He sought to do in mechanics precisely what is found in nature—to produce the strongest frame with the least possible material in quantity and weight. In this particular he succeeded beyond the wildest dreams of the early makers. If the reader will reflect how crude, clumsy, and heavy the original frame of the velocipede was when it appeared as a pacing machine, built with a wood frame; how the bicycle followed, with a heavy iron frame, and, lastly, the safety, with its thin steel tubing—a marvel of lightness and strength—he will realize how slow has been the evolution of the bicycle.

At first thought it seems fortunate that the bicycle builder has preceded the engineer in his work of perfecting the automobile, but experience does not justify this conclusion. With the splendid achievements of the safety bicycle before him, the designer of the new vehicle has largely disregarded the lesson so plainly taught him in bicycle construction, and almost wholly omitted from the automobile the use of the tube. This is a singular error.

At the present time—the end of this century—the leading manufacturers of automobiles in the United States are imitating horse vehicles, and build on the old-fashioned carriage-makers' lines of design and method. It is the purpose of the writer to point out how this mistake is made, and suggest the remedy, having a faint hope that it is possible to save time and money in the evolution of the ideal automobile.

It seems perfectly natural that the automobile constructor should imitate the carriage-builder—first, because his work was similar, and, second, his desire to please the public, which had no other standard of taste than the horse carriage. The first thought was to make a four-wheeled vehicle to carry two or more people comfortably, gracefully, and steadily, and having

the mysterious power to propel itself. This labor was chiefly mechanical in its inception, for a machine with sufficient power and under perfect control must first be produced. Greatly to his credit the engineer solved this problem, but so absorbed was he in his mechanical work that he seems to have overlooked the important conditions of weight and material, and overbuilt the vehicle in all its essential parts. In the end this mistake will prove beneficial, because the engine required to drive an overbuilt machine will exert more power than required to propel one of less weight.

In this connection let us consider a single example. The body and running-gear of its electric cabs, as now constructed in America, aside from machinery and storage battery, weigh 2,200 pounds, and the load to be carried is two persons and one operator, estimated at 600 pounds. To this add 1,600 pounds of battery and 500 pounds of machinery, making a total of 4,900 pounds. From this it is plain that seven times the weight of passengers to be transported is employed in the weight of the vehicle.

With tubular construction of frame and body, at least 1,200 pounds can be eliminated in weight, together with 800 pounds of battery and 200 pounds of machinery, making a total reduction of 2,200 pounds—a little more than one-half the weight of the entire vehicle. We are aware that improvements in batteries as well as motors have been made. These reduce the weight, but the principle remains the same, for whatever reduction is made in the weight of the vehicle is a saving as well in the weight of motor power. If tubular construction be generally used in the body and running-gear of the automobile vehicle, the greatest strength and least weight will be realized.

The second cause which led to heavy-weight automobile construction was the natural desire of the maker to please the people, and he constructed the vehicle to resemble the horse carriage. This, to some extent, is a pardonable offence. The designers of horse vehicles have been employed for centuries, educating and cultivating the taste of the people to their standard, and in this they have succeeded to fix and prejudice our judgment.

It is but natural that the automobile designer should shrink from changing these conditions, and give to his patrons, as near as possible, the same thing. But the time has arrived when originality must take the place of imitation and copy, and the ultimate creation must be a distinctive automobile vehicle.

Why Not Send the Horse to School?

By Sylvester Baxter

IT would be greatly to the advantage of both the horse and the automobile if training-schools for horses were established in every centre of population. The greatest drawback to a much more rapid introduction of the latter for domestic purposes, both of pleasure and general utility, is the fear of frightening horses.

"I should get me a motor-carriage at once; it would be more convenient in every way, and save me a deal of expense and trouble. But I think I shall wait awhile until horses get used to them. I do not want to be continually haunted by the fear of frightening them and causing runaways, smash-ups, serious injuries, and perhaps loss of life. After a while horses will take them as a matter of course, just as they do bicycles, and then I will lose no time in getting me an automobile."

One very frequently hears remarks of the foregoing tenor. Public sentiment is almost universally favorable to the automobile. Its advent is sure of a hearty welcome all along the line, with the exception of the comparatively insignificant factors, even though large and extensive in themselves, devoted to maintaining the old order of things. The uncomfortable obstacle is as aforesaid, lying in the difficulty of reconciling a very sensitive animal to the presence of his mechanical rival on the thoroughfares. If this obstacle could be overcome it would benefit the horse and his owners as well as it would the automobile interests, for thousands of persons are abandoning the use of the horse, even before they are ready to adopt his substitute, simply for fear of his taking fright at any unlooked-for moment under the ever-increasing occupation of the highways by other forms of traction.

This process of abandonment was well under way even be-

fore the coming of the automobile, largely in consequence of the multiplication of bicycles, until they have to an enormous extent attained the majority among vehicles on the public road, and likewise because of the extension of electric-car routes throughout all the populous sections of the country. The necessity of constantly encountering these things, and consequently of being ever on the lookout for careless wheelmen riding with heads down, or on the wrong side of the road, or without lanterns at night; or for the coming of electric cars at crossings or curves—all these things are apt to induce such a condition of the nerves as to make even " pleasure-driving " anything but a pleasure for the one who drives. Therefore a large proportion of the thousands who have found delight in visiting pleasant rural scenes, or the beautiful parks of the large cities, and who have depended upon horse and carriage to get there, have come to deprive themselves of a form of daily or regular recreation that was once one of the greatest of their sources of enjoyment—simply for the reason that conditions of fear have grown to outweigh the conditions of pleasure.

And now, with the coming of the automobile, this unpleasant condition of things will naturally be greatly augmented unless something is done to mitigate the situation very essentially. So why not send the horse to school? The education that he gets at present he picks up at random, for the most part, much like the street-urchin of the city, learning whatever happens to come in his way, but omitting to learn many desirable things that would stand him in good stead on occasions. All horses come to town from the country, and it is commonly in the country that they receive the schooling for the road known as " breaking in." And the thousands that come to live in the city adapt themselves to the irritating conditions of urban life mainly by the experience acquired as they are driven about the streets. Not infrequently, however, something happens that their experience has not prepared them for, with dire consequences to those about them, if not to themselves.

The horse's training in the country nowadays includes, of course, familiarity with the bicycle, and to a considerable extent with the trolley-car as well as the steam-cars. But even now, when bicycles are everywhere thick as blackberries, so to speak, at times we hear of a runaway caused by fright at a bicycle. It seems as if almost anything—perhaps even a bucketful of oats! —would scare a horse out of his senses should he happen to see it under circumstances at all unusual.

Although the horse has a very small brain capacity for a

creature of his size, he seems to make up in acuteness of perception for his deficiency in judgment. He is quick at recognition, and has a retentive memory. He is therefore amenable to instruction, as a rule. The accomplishments of the circus-horse are good evidence of this. And though congenitally one of the most timid of beasts, the horse can so readily be adapted to extraordinary conditions that he can be made to achieve at least the semblance of valor. He advances fearlessly into battle, and delights in the rush of conflict, the clamor of war—unheeding frightful sounds in vast accumulations, any one of which would be sufficient to strike terror to his heart if heard under ordinary circumstances. All this is done by schooling. So the horses of a city fire department likewise seem to take huge pleasure in the excitement of alarm, the intense rush to the scene of action, the tremendous clatter and clanging of the apparatus, the streams

of flying smoke, and the confusing steam. It is the unwonted that terrifies the horse, and if pains should be systematically taken to accustom him to all sorts of unwonted things and circumstances, the danger of his taking fright would be very much diminished.

It has been observed that in the first stages of an innovation in the vehicle line there is commonly an epidemic of horse-frights and runaways. But after a while the horse seems to accept the situation, and go his way unconcernedly in presence of the strange thing. Even green horses from the country, on beholding one of these city spectacles for the first time, are not unlikely to take the experience quite tranquilly. Perhaps they notice that other horses accept the thing as a matter of course, and so they conclude to do the same. Horses, in common with other animals apparently, have some means of intelligent communication with each other, and so when a new thing comes up, like the bicycle, the trolley-car, or the automobile, those who have got used to it pass the word around to all of their kind not to

mind the thing; it won't hurt them one bit! Some hold that this is done by telepathy. And since scientific investigation appears to have established the fact of thought-transference, there seems to be no reason why it should not occur in some degree among the lower animals as well as among human beings. But after all, it seems best that we should make sure of the training of the horse in respect to the things that are liable to make him lose his head rather than leave him to pick up his knowledge from the fellows of his species.

There are certain features about the motor-vehicles that make it perhaps more difficult for a horse to get used to them than to the other things that successively have been trying his nerves in the course of the present century. In the first place, the automobile is a carriage, and the horse perceives the fact. Therefore, he cannot understand how it is that a carriage should move along without a horse to pull it. He is alarmed by the noise made by some; and the clouds of steam that proceed from others apparently make him think that a locomotive has escaped from the rails and taken to the highway. And the electric-cab, in its earlier shape at least, in its bulkiness of aspect reminds him of the hated steam-roller. Motor-bicycles and even tricycles are least likely to give him a fright, unless they make too great a noise, for they look like more familiar things.

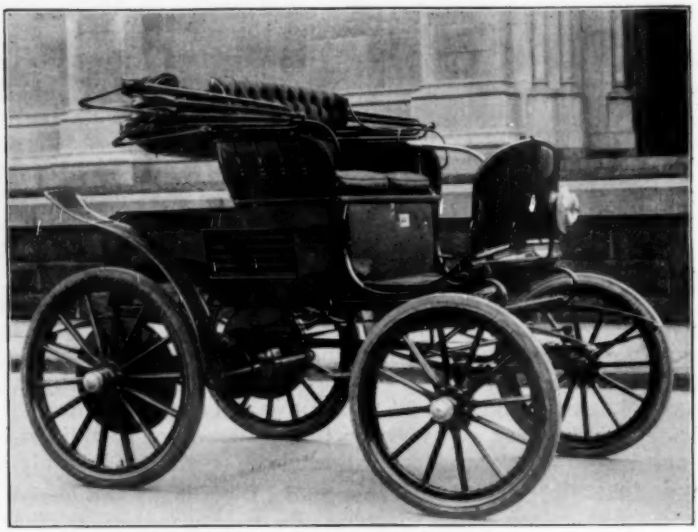
In the large cities, where the automobile is coming into use, a training-school for those who are to run them is one of the essentials. In this sort of a school, besides practice under skilled teachers in ascending and descending grades, making curves, turning corners, etc., the avoidance of all kinds of obstacles is taught. To this end the way, here and there, is obstructed by all sorts of things that one may at times encounter in the highway—sticks and stones, brickbats, bicycles, baby-carriages, wheel-barrows, and dummy figures representing nursery maids, old women, drunken men, policemen, etc. Among all these things the driver of an automobile is taught to steer his way with care and precision.

Now, why should not this institution also be utilized as a school for the training of horses in paths of familiarity with things that are liable to cause them fright? If this were done, it would be equally useful on both sides. The user of the automobile would have practice in the most important matter of knowing what to do in the presence of horses; how to pass them on the road face to face, or coming up from behind, and how to act with presence of mind when a horse gives the slightest indication of showing fright. On the other hand, horses would have the very

best of opportunities to get used to the various classes of automobile. Not only this, but the course of training for the latter should comprise all possible things under all practicable circumstances in the way of startling sights and sounds: the flapping of awnings; the flaunting of banners; newspapers, etc., blown about the road, and under a horse's feet; all sorts of strange things lying about the highway, of which the obstacles placed for automobile practice would in themselves furnish a goodly variety; the explosion of fire-crackers and torpedoes, the firing of pistols, rifles and cannon, "German bands," and Salvation Army bass-drums!

A certificate of thorough instruction, with lessons well learned, given by such a training-school would be appreciated by purchasers of horses, and would soon be likely to be demanded by them. It would even be well if it should be required by law that no horse should be sold without the giving of such a certificate, for the very good reason that a horse not so trained is an animal too dangerous to be allowed the freedom of the highway in these days.

Gallery of American Automobiles

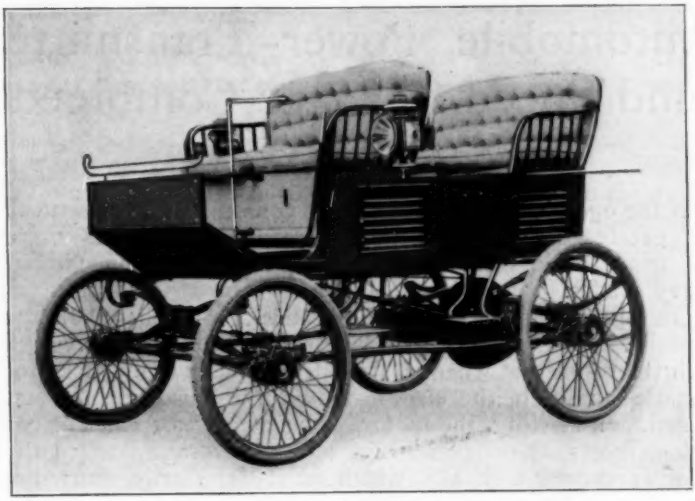


American Electric Vehicle Co.—Stanhope.

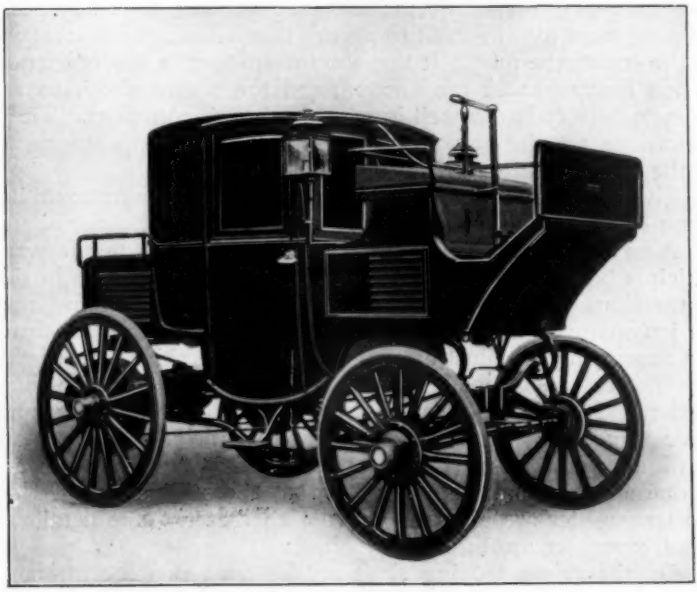
American Electric Vehicle Co.—Brake.

(This Department will be a regular feature of the AUTOMOBILE MAGAZINE.)

Gallery of American Automobiles



The Riker—Brake.



The Riker—Coupé.

(This Department will be a regular feature of the AUTOMOBILE MAGAZINE.)

Automobile Power-Transmitter and Speed-Changer Combined

By E. E. Schwarzkopf

IN the operation of automobiles as constructed at present, the greatest drawback to their successful operation is derived from the loss of power in sudden starts and in climbing heavy grades.

In all the existing designs of electric automobiles the motor is positively connected to the axles or the wheels of the vehicle, with the result that when it is required to start the vehicle from a static condition, the electric motor must also be in a state of rest. In starting, the motor, being at its least efficient condition, meets its severest strain, and the storage battery thus receives excessive shocks, which must necessarily shorten its life. It must be remembered that the vehicle has to be gradually started from rest to a required speed, during which time it is necessary to use resistance, causing a great loss of energy. Resistance must also be used to permit the vehicle to trail wagons in the street, the motor at this time running at a low efficiency. When heavy grades are encountered the severe shock to the storage battery is too well known to require comment. These conditions are the principal causes of the rapid disintegration of the storage battery.

The same wasteful condition of energy exists in automobiles when driven by either a gasoline or steam engine.

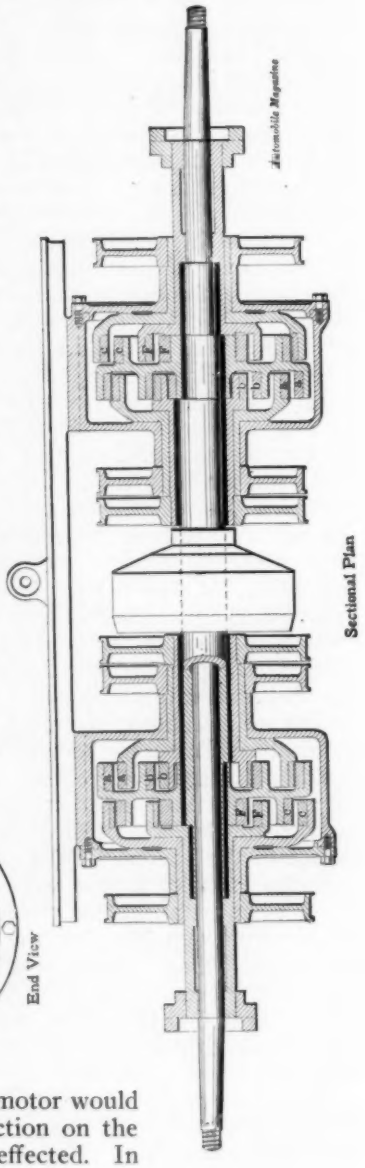
A new mechanical invention has recently been put forward which is bound to prove an important factor for service in this connection. It is designed to overcome the various drawbacks we have enumerated as existing to-day. It will be clear, from the accompanying illustrations, that many combinations of this transmitter can be made other than those shown in the illustrations. It will be noticed that in all the illustrations the same basic principle is used in transmission, namely, a new system of differential gears; that the prime and last movements are in one straight line; and further, that the strains imposed on the transmitter are all of a tortional character. The details of this transmitter are briefly as follows:

On the prime moving shaft are fastened two eccentrics of equal diameter, equal face, and equal throw; the throws of ec-

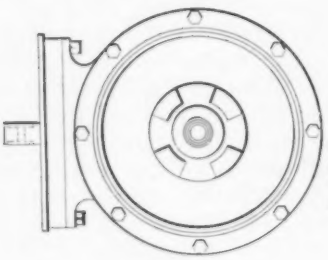
centrics are set diametrically opposite each other; thus the eccentrics are in equipoise. On these eccentrics are loosely mounted two discs, having fastened to them on both of their faces either internal or external gears, and meshing with these gears are respectively external or internal gears. One of these latter gears is fastened to the last mover, the balance being fastened to flanges operated by the brake mechanism. The last mentioned gears act as fulcrums in transmission, while the gears attached to the last mover and those in mesh with same act as levers in this combination. In order to transmit motion to the last mover in this transmitter, it is necessary to hold, through the action of the brakes, one of the fulcrum gears. These brakes are operated either by hand or electrically, and it will be plain to those skilled in the art that this transmitter, driven by one motor, will have, in addition to the function of differential speed of the last mover, with a proportionate increase of torque for overcoming the inertia of the vehicle and its load in starting for varying its speed, owing to the conditions imposed by street traffic or for hill-climbing, also the function, without further complications, of permitting the vehicle automatically to turn curves. In order to make this clear to the lay reader, we will refer to the illustrations showing this invention. In Fig. 1 this transmitter is shown with its electric motor mounted on the axle of the vehicle; on each side of the motor are shown duplicate transmitters connected on each side to a carriage wheel, both transmitters possessing differentialities of speed from that of the motor in ratios of 35 to 1, 13 to 1, and 7½ to 1. All the brakes are electrically operated. To explain this brake action a rheostat is set close to the hand of the driver, having three points of contact respectively connected to the brakes on both sides, engaging the three differentialities enumerated. The wires from the rheostat lead first to the steering handle of the vehicle, and thence to the brakes. If the driver wishes to turn to the right, then the electric current which actuates the brakes operating the left-hand transmitter would be cut out, and the left-hand wheel would run idly, but the transmitter connected with the right-hand wheel would positively drive the vehicle around the curve. Referring to Fig. 1, and in order to clearly show the functions of this invention, we will assume that we start the vehicle. At this time the motor would be stationary. The operation would be as follows: the driver would switch the current to motor, when the motor would idly revolve to its highest efficient speed, having no connection to the axle of vehicle, until the driver engages the brakes through the rheostat. He first

engages the brake which gives a differentiality from the speed of the motor of 35 to 1 with its proportionate torque, and thus overcomes the inertia of the vehicle. He then moves the rheostat to engage the brake giving the differentiality of 13 to 1, and in turn moves the rheostat on to engage the ratio of $7\frac{1}{2}$ to 1, driving by the last combination the carriage to its full speed.

It must be clear that in the operation of the cycle we have given, no excessive draught on the storage battery has been made, the vehicle having moved from a static division to, say, fifteen miles per hour. To stop a vehicle operated by this transmitter the driver would, by the aid of the rheostat, reverse the cycle before given, and the vehicle, by a cushioned effect, would pass through the several differentialities of speed governed by the transmitter. By placing the



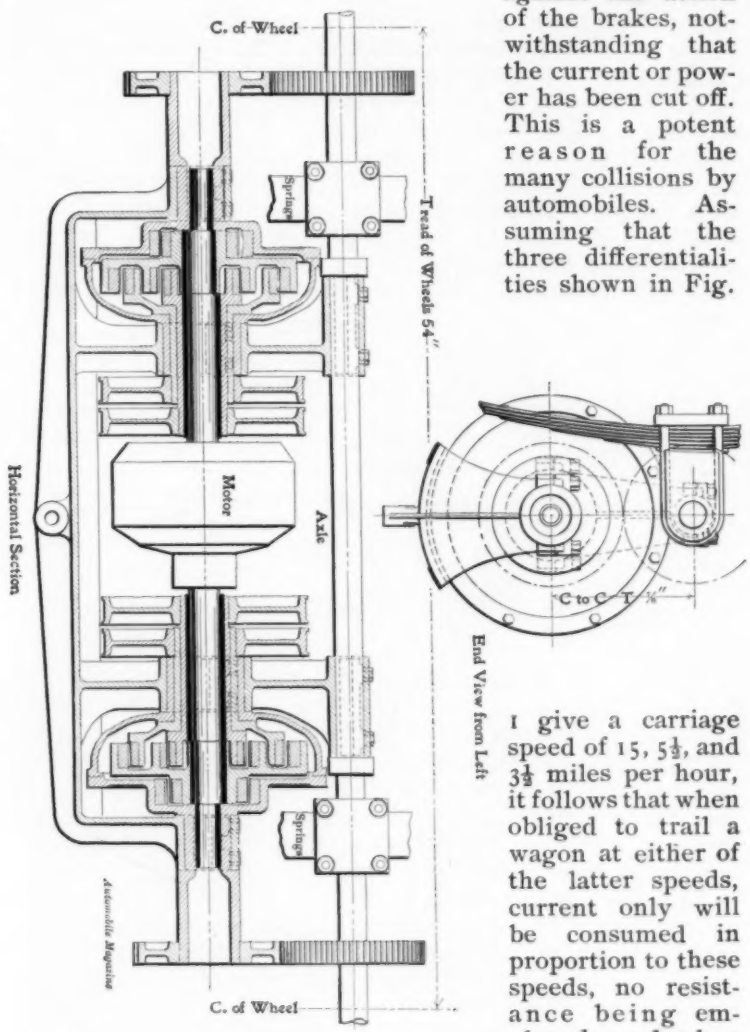
Sectional Plan



End View

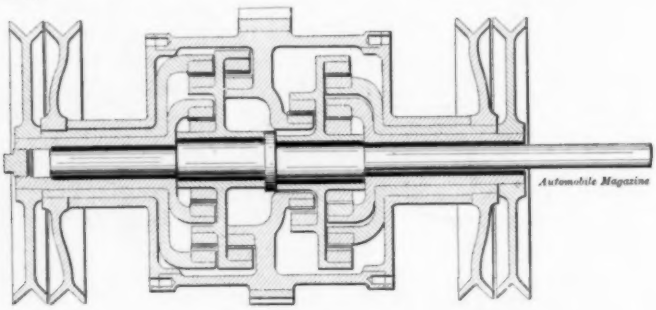
rheostat on the dead point, the motor would revolve idly, and, having no action on the vehicle, a quick stop would be effected. In

all known types of automobiles, when a stop is desired, the prime mover by its own momentum still drives the vehicle against the action of the brakes, notwithstanding that the current or power has been cut off. This is a potent reason for the many collisions by automobiles. Assuming that the three differentialities shown in Fig.



1 give a carriage speed of 15, 5½, and 3½ miles per hour, it follows that when obliged to trail a wagon at either of the latter speeds, current only will be consumed in proportion to these speeds, no resistance being employed; and when climbing excessive grades the leverage on the carriage axle would be increased in direct proportion to the higher ratio of the

differentialities employed. In Fig. 2 is shown another combination of this transmitter, the last movers being a gear in mesh with a gear fastened to the carriage axle. The alignment of the transmitters with the axle is positively secured by their being yoked to the same, the frame of transmitter on the opposite side being fastened to the carriage body by bolt. By this arrangement of suspension the alignment of the transmitter to the carriage axle is always preserved irrelative to the position of the carriage body, owing to the contraction or expansion of the carriage springs. In this combination there are two differentialities on each side, the same automatic arrangement as shown in combination Fig. 1 for turning curves being retained. The one differentiality would be used for the full carriage speed, the other for overcoming the inertia of the carriage or as a hill-climbing device.



In Fig. 3 is shown a combination of this transmitter for driving heavy delivery wagons. In it is shown three go-ahead speeds and one backing speed. We believe that in this class of automobiles the possibilities of this invention will be clearly shown, as all experience to date has proven the absolute necessity on this class of vehicle of variable speeds, with their proportionate increase of leverage in addition to the added function of backing the vehicle.

Judging from the above, it seems safe to state that the Birrell transmitter, herein described, overcomes many serious drawbacks extant in the automobile of to-day. It is simple in design, cheap in construction, self-contained in its arrangement. As a mechanical construction it is said to have won the approbation of many competent engineers in this country and abroad.

The New Sport Abroad

(By Our Own Correspondent)

THESE late autumn days in Paris have been delightful for lovers of automobile sport, who are taking ample advantage of the charming weather, filling the roads of the Bois with a kaleidoscopic variety of their vehicles, and presenting a spectacle which for a stranger affords a marvellous testimonial to the universality of the new form of locomotion. Even the Parisian never tires of its fascinations, and finds one of his greatest delights in watching the movement that shows the supremacy of his beloved capital in the latest contribution to modern mechanical achievement.

One of the most interesting things for us lies naturally in the fine additions made to the magnificent house of the Automobile Club. These include new dining-rooms, salons, and a beautiful little theatre, which will make a capital place of assemblage for the international automobile congress, which will probably be a feature of the Exposition next year.

Every new interest, of course, develops its freaks, cranks, and 'phobiacs. The worst instance of automobiliphobia I have heard of is that of a citizen of Cobourg, a village near the mouth of the Seine. This man, who lives in a villa with grounds bordering on a frequented highway, has somehow conceived an insane hatred for the automobile, and has devised a fiendish sort of contrivance to carry his malice into effect. He has cut off one of his trees at the ground, and converted it into an automobile-trap by hinging the trunk to the stump. He holds the thing in place by a kind of tackle, by which it may be dropped across the road when an automobile draws near, just in time to assure a collision. Either a lunatic asylum or a prison should be the destination of this iconoclast.

French Tree Trap.

The Automobile Magazine

There is a deal of talk about making long-distance tours into remote parts of the world—but until the era of universal good roads arrives these must necessarily remain in the air, the projects of uninformed enthusiasts. The ways are so bad in these remote lands that one might as well attempt to run an automobile down the rocky bed of an Alpine torrent as try to go over them. Thus there was much talk about a race from Paris to St. Petersburg, but even our national affection for the land of the bear would hardly be sufficient to induce the most intrepid of our *chauffeurs* to venture upon the journey after the report of the committee that undertook to investigate the subject. M. Thevin, who went over the route as a delegate for the committee, or attempted to go over it, speaks in high praise of the German part of the journey, for there he found the roads perfect, but of the Russian portion he said: "The roads only exist on the maps; the pools of mud and the wretched swamps are not to be dignified by the name of roads, and they would wreck the stoutest vehicle driven at more than six miles an hour." There are also long stretches of uninhabited wastes that would be most difficult to traverse.

Another chimerical-sounding project is that of an Englishman who proposes an automobile trip from Hongkong to Paris and London, starting next February. Dr. Lehwess, of London, is the man. He proposes to use a stout carriage with a motor burning ordinary kerosene. He thinks he can make the trip in three months! For the difficult stretch between Pekin and Khiachta, on the Russian frontier, a distance of 800 miles, he proposes to carry a kind of anchor, or grapnel, with a length of wire rope, to haul the car over otherwise impassable places. The men who made the various transcontinental bicycle tours found the obstacles well-nigh insurmountable, and it is a very different proposition for an automobile. Andree had a simple task in comparison. One might as well attempt to navigate an ocean liner overland. Fish should stick to the water, and automobiles to good roads.

In a recent trip to the other side of the Channel I was much impressed with the progress made in England. They have at last got rid of the great obstacles imposed by antiquated legal restrictions, and the Automobile Club of London is to celebrate the passage of the "Light Locomotives on Highways Act" by a great banquet.

There is a regulation of the British Local Government Board which provides that "light locomotives," as they say in England, shall stop at the request of any police constable, or of any person

A French Floral Prototype.

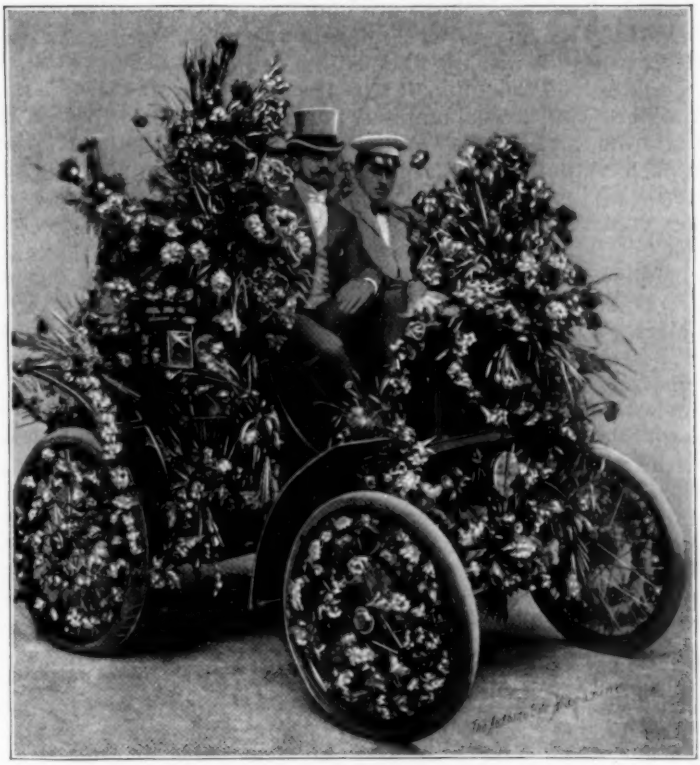
having charge of a restive horse. As this regulation is often being made use of simply for the annoyance of automobilists, the Automobile Club has issued a notice to drivers of motor-vehicles to the effect that only in certain instances, which are specified, does the right hold good to stop a "light locomotive," and that a person not the driver of a restive horse, or the driver of a horse that is not restive, has no right to require it to stop.

Newcastle-on-Tyne is to be the centre of an important "automotor service." A new company has been organized, called the North Yorkshire and South Durham Syndicate, to institute motor-omnibus lines along the banks of the Tees. Orders have been placed for two carriages to carry a score of passengers each, and six to carry ten each. These are to run between Stockton, Eaglescliffe, Yarn, Middlesbrough, and Marton Lane End, the service later to be extended to various other places.

Whoever has had the fortune to enjoy the hospitality of the Travellers' Club in London cannot easily forget the interesting persons from all parts of the world he has met there, as well as residents who have been in all parts of the world, and the many fascinating experiences and adventures there recounted. With the extension of the automobile to remote parts of the earth, we shall be likely to find our automobile clubs becoming centres just as entertaining in a similar way! We may even enjoy meeting some automobile lion-hunter, some Selous-on-wheels, so to speak, or listen to the thrilling account of grizzly-shooting by an automobilist among the Rocky Mountains! When your Rocky Mountain roads become equal to those of the Alps or the Black Forest—and they will be, sooner or later, for now we are going to have good roads everywhere—this will not be an impossibility, any more than it was for that talented countryman of yours to make those wonderful instantaneous photographs of wild beasts in action, in the heart of the wilderness. As it is, I remember that my learned Dutch friend, Dr. ten Kate, who was with Cushing when he made those extraordinary discoveries in your arid Southwest, told me that in Arizona it would be quite practicable to shoot rattlesnakes by the dozen from an automobile, the deserts there are so hard, smooth, and level.

But the nearest we get to such narratives at present is in tales of Alpine adventure from daring *chauffeurs*, who have made their way across the snowy ranges on the way to Italy or Austria.

A distinguished party has recently left Paris for an automobile tour of several months in Algiers and Kabylia. The party consists of Count Bosson de Perigord, who is the second son of



German Floral Show (Berlin).

the Duke de Talleyrand and Sagan, Count de Crisnoy, Count de Moustiers-Méronville, Count Marius de Gallifet, and M. de Lazarches d'Azay. As our French civilization means good roads everywhere it is carried, they will doubtless find smooth ways, and correspondingly pleasant experiences, for the greater part of their sojourn in African wilds. And perhaps we shall hear of the first automobile lion-hunt from them!

Last July Baron Duquesne gave us a pretty thrilling account of Alpine adventure on his automobile journey through Switzerland to Austria—an account calculated to discourage the most intrepid *chauffeur* from venturing into Alpine wilds. But perhaps the valiant Baron wanted to keep the field to himself! For now my friend, M. Baudry de Saunier, has lately had a letter from a

friend of his telling about a round trip just made from Vienna to Paris by the direct route, returning by way of Switzerland and the Tyrol—all without the slightest misadventure, and surmounting long and difficult twenty-per-cent. grades without any trouble. The heavy mountain work was pretty hard for the motor, he said, but his Dietrich vehicle sturdily overcame every obstacle without the least injury. He enjoyed the novel pleasures of a pioneer, for in crossing the Alps he went by roads the greater part of which were traversed by an automobile for the first time; the Simplon, at an altitude of 2,009 metres above the sea, followed by the Maloja at 1,811 metres, the Bernina at 2,330 metres, and finally the highest point with the Stelvic, at 2,814 metres.

For the automobilists of Munich, where motor-vehicles have achieved a remarkable vogue of late, the passage of the Brenner has become a favorite diversion. This famous historical highway crosses the Alps at an altitude of 2,034 metres. It leads all the way through delightful scenery, separates the Zillerthal Alps of the Tyrol from the Stubay-Otzthaler group. For time immemorial this pass has been the main highway between Germany and Italy. In the middle ages it was called the *Kaiserstrasse*, the Emperor's way, and up to the present time it has been the most frequented of all trans-Alpine highways. In 1772 the road was thoroughly rebuilt under Maria Teresa, and is now a fine example of mountain highway engineering. I once went over the route from Munich on a bicycle, and the memory of the glorious scenery is with me yet, although many years have passed since then. I well remember how pleasantly the highway impressed me as it wound along within sight of the train. Our brethren of Munich are to be congratulated on their fortune in possessing such a noble automobile route from their very doors into enchanting Italy. I hope to have the pleasure of retracing my trip some day on an automobile. The journey is practicable, not only for strong and heavy motor-carriages of eight or ten horse-power, but for the light vehicles of three horse-power or so. Baron von Franchetti, a devoted automobilist and musical composer, recently made the trip in a "Velo-Comfortable." Previous to the opening of the railroad in 1867, as many as 25,000 vehicles of all descriptions used to pass over the Brennerstrasse, as the Germans call the road, every year, but since then comparatively few have used it. Now, with the development of automobilism it will become again a very popular pleasure route. The road leaves the valley of the Inn at Innsbruck, and ascends through the Wippthal to the lake called the Bren-

nersee, which is famous for its good fishing. The posthaus at the summit is not far from the celebrated health resorts, the Brennerbad and the Wildbad, with warm springs, the water at the latter having a temperature of 21° centigrade. The descent is through the Eisackthal by way of Hohensass, Sterzing, Brixen, and Botzen into the Etschthal. At Botzen there is a wonderful view looking back towards the Dolomites. A slight detour takes the tourist to the famously beautiful Lago di Garda, which lies partly in Austria and partly in Italy.

A section of this route was the scene of a trip of the Bavarian Automobile Club, of Munich, the past summer. It was intended to make the entire trip from Botzen to Munich, but at the last moment difficulties in the way of stations for replenishing the gasolene supply presented themselves, and so the programme was shortened, making Innsbruck the starting point. There were twelve participators. The start was made at five o'clock on Sunday morning, July 23. Three violent tempests tested the qualities of the tourists and their vehicles. Baron von Dietrich-Luneville, in a handsome carriage of his own invention and construction, was the first to reach the goal, terminating the stretch of 173 kilometres at 10.55 o'clock—or in five hours and forty-five minutes running-time. His motor was of sixteen horse-power. This was the first mountain trip of an automobile club in Germany. Next year the club will doubtless make the entire distance across the Brenner.

A notable automobile journey was that made by a Berlin journalist and his wife in July, from Berlin to Paris and back. The trip was made by means of a motor-tricycle, with a two-seated voiture attached. An expert driver rode the tricycle. Four weeks were taken by the journey, which covered a distance of at least 2,400 kilometres, and crossed the Harz and Vosges mountains. There were no mishaps whatever, and the tourists returned to the German capital enthusiastic over their delightful experiences. The weight of the three persons and their baggage was about 545 pounds, the latter weighing about 150 pounds. Only about ninety litres of gasolene were used, at a cost of nine dollars. In the dry battery used with the motor, the same element sufficed for the entire trip. At starting it showed an energy of a little less than six volts; on the end of the journey it gave out four and a half volts.

An event of the season in Vienna was an improvised outdoor exhibition and parade, to which the owners of all motor-vehicles at the time in the city were invited by the Austrian Automobile Club. The response was general, and a great variety of vehicles

took part. The meet took place on the old Exerzier platz in front of the Franz Josef barracks. Among the participators were distinguished personalities like the Count and Countess Kielmansegg, Baron Springer, Count Pötting, Baroness Haas-Wächter, Consul-General Singer, and Dr. Suchanek. Several excellent photographs of the company were taken, and then there was a parade through the principal streets.

The Rheinischer Automobile Club is the latest of the organizations that testify to the rapid growth of motor-vehicle inter-

Group of Vienna Exhibitors.

ests in Germany, a country that now stands second only to France in the advances made. The new club makes its headquarters in Mannheim, the pioneer city in automobile manufacturing in Germany, and has for its field the Rhine countries of Baden, Hessen, and the Palatine.

The enormous growth of the automobile interests in Germany is shown by the important general exhibition opened in Berlin on September 5, with 120 exhibitors—of whom eighty-two were from Germany, thirteen from France, four from Belgium, and two from Switzerland. These makers were represented by 140 different vehicles. The national government testified its interest

Viennese Ladies in their "Schnauferl."

by sending the State Secretary of the Post-office, General von Pobbielski, to open the exhibition. The progressive Post-office Department of Germany will naturally be quick to avail itself of the advantages for facilitating its work presented by the automobile. The opening of the exhibition was also celebrated very appropriately by the Berlin Omnibus Company, in beginning its service of electric omnibuses, running at a maximum speed of thirteen kilometres, or about eight miles, an hour.

In the Low Countries there are some curious restrictions placed upon automobiles. In Amsterdam, for instance, they are forbidden upon a street paved with asphalt! And in Belgian towns the speed-limit is placed at ten kilometres an hour. There are reports of internal troubles in the Automobile Club of Belgium. Some of the more energetic members are talking of a new club with more "go" to it.

A comical instance of rustic avarice comes from Normandy. A peasant made complaint against an automobilist who ran over a duck and a drake belonging to him, and made out a bill of damages for thirty francs, charging seven and a half francs apiece for each of these items: (1) The drake; (2) the duck; (3) the eggs that the duck would have laid, and (4) the ducklings that would have been hatched from the eggs! And the court made the automobilist pay! Since the Dreyfus affair anything seems to pass for justice.

Petroleum Motors

THE high economy which may be obtained by the complete combustion of liquid fuel in an internal-combustion motor, according to the *Engineering Magazine*, is now generally conceded, and as a result there have been numerous attempts to design motors which shall prove acceptable for general use. The Diesel motor has been fully noticed in the columns of the American technical press at various times, and now we have the Dopp motor, which was discussed at a recent meeting of the Verein deutscher Maschinen-Ingenieure.

Dopp maintains that the high compression advocated and used by Diesel is not necessary to the attainment of superior thermal economy, and claims that equally good results can be secured by the use of vaporized petroleum, drawn into the cylinder with the proper proportion of air, and burned under practically the same conditions as obtain when gas is used in a well-designed gas-engine.

Petroleum Motors

It seems to be generally admitted that the main element in the economy of a petroleum motor lies in the complete combustion of the fuel. While this is secured by providing a compressed atmosphere, it does not appear that it is necessary to use a compression materially greater than is now employed in the gas-engine. The Dopp motor does not differ in general construction from an ordinary gas-engine, except that the petroleum fuel is gasified by the heat of a lamp before it is drawn into the cylinder, and the excellent economy which appears in the regular service is claimed to be due only to the completeness of the combustion, attained by a thorough mixture of the fuel with the proper quantity of air.

Herr Dopp gives figures from a number of his motors in daily use which show a consumption of 0.197 to 0.240 kilogramme of petroleum per horse-power-hour, the lower result being obtained with a ten horse-power motor after it had been in practical service for more than eleven months. This result is better than was attained by the Diesel motor of twenty horse-power tested by Professor Schroter, although under less favorable conditions.

Herr Dopp maintains, as has been claimed by others, that the Diesel motor by no means realizes in practice the theory enunciated by its designer, and shows that some of the fundamental points, which, according to the theory, are essential to the highest economy, are distinctly controverted in the working of the motor. From this he deduces that the high economy of the Diesel motor shows that the theory is not sustained.

An important feature of the motors constructed by Herr Dopp lies in the fact that they can be constructed and operated in a satisfactory manner for small powers, good results being obtained with motors of two to five horse-power, while the construction of the Diesel motor is such that it does not appear advisable to make them for less than twenty horse-power.

Regardless of the theoretical questions at issue, there seems to be little doubt that very simple, efficient, and convenient petroleum motors can be made upon the same general design as that already in public use for gas, and that care in design and in the correct proportion of air to fuel supply can, with a moderate degree of compression, insure such a complete combustion as to leave little or no trace of soot either in the cylinder or in the exhaust gases. Under such circumstances there can be little doubt that the petroleum motor has a most useful future before it, especially for small powers.

Axle Bearings

By Myron and Frederick B. Hill

SOME of the advantages and disadvantages of a few of the bearings which have been employed at various times in the endeavor to eliminate the factors of friction and wear form an interesting study.

The plain axle bearing, often called the parallel bearing, was naturally the first and simplest method of mounting a wheel upon an axle. As long as we could count on draught animals to overcome the friction in vehicles, the need of better bearings was not so obvious. But with the advent of the bicycle, when the burden fell upon man himself, came the demand for a bearing involving less friction in the running parts. The wear and the necessity of frequent lubrication were so troublesome that some more convenient and economical bearing was demanded. First, cone bearings were tried, and then the well-known ball bearing. And now in more recent times the development of motor vehicles has created the demand for a new bearing which will sustain greater weight than the ball bearing, and still eliminate as much friction and trouble as possible. It is this age of automobiles which has brought into use the roller bearing.

Let us first see what has been accomplished with parallel bearings. In laboratory experiments it has been found possible to obtain a coefficient of friction as low as .001, but this was under conditions theoretically perfect and such as could never be secured on the road. It was with a bearing that was highly polished, but not worn, and with an expensive lubricant lavishly applied. Moreover, this low coefficient was maintained for a short period only, and was soon increased with running and the consequent wear.

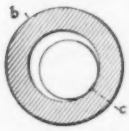


Fig. 1

Experiments with good parallel bearings, such as are used on vehicles, have shown fair results. At a moderately high speed, such a bearing, if supplied with sufficient and well-distributed lubricant, will have a coefficient as low as .07 or .08. This is, of course, when the bearing is new and free from wear.

In Fig. 1 is represented a section of a parallel bearing, showing in an exaggerated way how the axle rests within the hub, touching on the side *a* only. The weight upon the axle, combined with the pull or forward motion, causes the contact

at this place. In action, the hub slowly wears away, and, as it is soft metal, there is more aggregate wear than upon the axle, although it is distributed over its surface. But the wear upon the axle comes all on the under side, and if the hub is .003 inch loose, not much more than that amount of wear on the axle causes it to assume a form somewhat like that shown in Fig. 2, with the surface of contract extending from *b* to *c*. This causes the surfaces to bind on each other, and, as they have the same curvatures, the distribution of lubricant becomes more difficult. The extent of this surface of contact depends upon the comparative wearing qualities of the hub and axle.

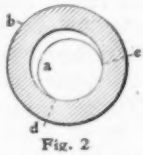


Fig. 2

This wearing away of the axle and the resulting deterioration of the lubricant largely increase the coefficient of friction, so that it runs up sometimes to .20, or even .30, and the loss of power becomes a material factor. The average coefficient of parallel bearings running at low speeds, fifteen miles an hour or less, is variable and difficult to determine, but probably lies somewhere between .15 and .30, dependent of course upon the speed, the weight carried, the character of the lubricant, and the amount of wear received by the bearing. The factor of end-thrust also adds materially to the loss of power.

To reduce the wear on the axle, which is expensive to replace, the bearings in heavy automobiles have sometimes been made of soft metal, but it has been proven that the life of such bearings is short, lasting but a few months only under ordinary conditions. Another factor which affects the wear and life of parallel bearings is the mixing of the worn particles of metal with the lubricant.

The chief disadvantages, then, of the parallel bearing are the loss of power, the requirements of constant renewal of lubricant, the occasional renewal of the bearings, and once in a while a new axle. Then there are the dangers of hot boxes and abrasions, due to poor distribution of lubricant or carelessness in applying it, or to the presence of sand or dirt. Under the weight of a heavy automobile, the pressure and binding are at times severe and the distribution of lubricant so poor that there is considerable abrasion; that is, the softer metal of the bearing is torn away, thus ruining it.

The difficulties and disadvantages of parallel bearings proved so great with the early form of velocipede or bicycle that some other bearing was sought which would have, not only a greater efficiency, but also a long life and little need of attention. Cone

bearings were then resorted to, and they proved to be superior to the parallel bearing in many respects. The best feature of the cone bearing, of course, was its adjustability to take up wear, and the fact that it did not bind so much after a slight amount of wear. It was quickly superseded, however, in bicycles by the well-known ball bearing, which has been found admirably suited to this class of work. The suggestion has been made that the origin of the ball bearing is found in the difficulty of making roller bearings work. The first experiments in the line of roller bearings were undoubtedly with cylindrical rollers. These, however, when not supplied with guides, had such a tendency to twist and bind in the bearings, causing them to heat up or smash, thus ruining them, that they were found impracticable, and the inventor of the ball bearing probably made up his mind that it was necessary to have a roller that could twist and turn at will without interfering with the ease of running. A spherical roller was the outcome.

For the light work of the bicycle, ball bearings are undoubtedly superior to any old-fashioned roller bearing, for in the latter the rollers rub against each other along the *line* of contact between them or against the cage confining them, whereas in the ball bearing the balls rub against each other on *points* only. For heavy vehicles, however, the demand for a greater rolling surface to sustain the increased pressure prevents the use of ball bearings from becoming general.

The original form of ball bearing, in which the balls rest upon flat cones, presents many difficulties for heavy work; the weight upon the balls is sustained upon points, and as the balls roll, the wear comes upon a line around each ball and upon a single line about the cone. With a light weight the wear may be slight upon well-hardened tool-steel balls and cones, but with the heavy automobiles of to-day, weighing several hundred and even several thousand pounds, the wearing action upon the balls and cones is very great. Under such conditions the ball flakes and grinds away, and the cones wear correspondingly. Before long, unless the cones are constantly readjusted to distribute the wear, the wheel wabbles. In practice the cones are apt to be left until the wear on one side becomes noticeable, and then adjustability is lost, for if the cones are screwed up to keep the ball tight on the side not worn, the balls will be loose on the side that is worn, and then the end thrust on the wheel causes it to rock. On the driving-wheel of a motor vehicle this rocking action twists the teeth on the pinion and gear at angles with each other and injures them.

A ball bearing quickly develops these conditions, and the fault is due to a slight rolling surface, scarcely more than a line. The cones and balls wear off, the cone becoming grooved, and the balls flattening and losing their spherical shape. Before long, if the adjustment is close enough, they are apt to twist, bind, and break. This is one of the frequent causes of broken ball bearings encountered by the bicycle-repair man.

Many attempts have been made to minimize this trouble with ball bearings. The most praiseworthy ideas, apparently, are the concaved cones and the " staggered " balls.

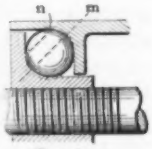


Fig. 3

In the concaved cone we have a surface which fits more or less closely over the surface of the ball, as shown in Fig. 3. In this form of ball bearing the balls may have the same curvature as the cones, or a smaller curvature. If the same, the zones of the ball on either side of the equatorial line *m* rub on the cones; the circle *n*, for example, is smaller than the equatorial circle *m*, yet it runs upon larger diameters of the cup and cone. It is dragged to make up the difference, so that an efficient lubricant is essential. The wearing of the balls, the deterioration of the lubricant due to the presence of worn steel particles therein, and the friction of the dragging surfaces are the evil features of such ball bearings. The loss of power due to this dragging action is a particularly objectionable feature.

If the curvatures of the cup and cone are slightly greater than that of the balls, the rolling action comes upon a line which crystallizes and wears away, so that considerable surfaces of the balls come in contact with the cup and cone, and the resultant bearing is similar to the one just described. Such a bearing is adjustable only within slight limits, and this also shortens its life.

In the " staggered " ball bearing the balls are held in a cage, so that each ball runs on a different line from its predecessor. This increases the rolling surface upon the cone, and undoubtedly increases the wearing quality of the cone, yet, as each ball has to wear its own groove in the cone, the wear upon each ball is more rapid than it would be if they all ran in a single line about the cone.

From this consideration of ball bearings it is apparent that some bearing is essential which has a greater rolling surface.

The automobile has thus introduced a new problem. The friction, wear and tear, and attention which are incidents of the parallel bearing, and the smaller rolling surface and conse-

quent wear of the ball bearing, make them unsatisfactory for the increased weights and strains of the motor vehicle.

Some ask, "Why not use the parallel bearing in spite of these disadvantages?" They argue that it has been adopted universally by road vehicles. The answer is this: There are two great differences between motor vehicles and horse-drawn carriages. In the first place, a horse-drawn vehicle has no complex mechanism to be attended to. The mechanism of the automobile, from its very nature, requires so much attention that the demand is strenuous for a vehicle requiring the least possible overhauling. Parallel bearings require constant lubrication. It is necessary for bearings and all running parts to be of such nature that they will require the least amount of attention. The difference of a few dollars in the first cost of the bearing parts will save constant expenditure of time and money afterwards. And, secondly, in the horse-drawn vehicle the difference of 10 or 20 per cent. in the power required to haul is lost sight of, for the horse is depended upon to overcome all friction. So here the loss of power through friction is not an obvious matter of expense.

In livery stables, of course, the overhauling of the bearings has been a material factor of expense, and many efforts have been made in past years to devise a successful roller bearing. All such efforts have had such dismal results as to give roller bearings a setback, from which they are but just recovering. The faults in the past have been in the failure of inventors to understand the necessities of a roller bearing. In a road vehicle a bearing is subjected to twists, strains, and end thrusts, which have to be provided for. Rollers have been used without any guiding or controlling device in some classes of work, but in vehicles they veer around and break sooner or later, the pieces going end over end, and the bearing is rendered worthless.

Some controlling device is, therefore, essential for a successful roller bearing. And the best roller bearing is the one having the best controlling device. This device must guide the rollers and keep them parallel with the axle, for, if they twist, the hub side of the bearing will rest upon the ends of the rollers, and the axle side upon the middle of the rollers, and the consequent binding of the bearing often causes the roller to break. This binding will happen sooner or later with the most perfect vehicle roller bearing which is not provided with some guide for the rollers. Moreover, when not guided or separated, the rollers rub against each other in opposite directions on their lines of contact, causing much rubbing wear and resistance against the

operation of the bearing; and when rollers vary in size, from wear or other causes, they roll at different rates of speed and grind upon each other, and the wear between them is more rapid.

Various devices have been resorted to for guiding rollers. Rollers have been mounted in slots, in brass or iron cages, or upon pivots in cages. The pivots and slots are so constructed as to hold the rollers in a correct position on the axle. A great many forms of such cages have been devised, some of them so successfully as to last a considerable number of months and stand the wear and tear of several thousand miles. The great fault in such bearings is the wear upon the cages. Sooner or later the rollers will drill through the cages or wear away the slots or pivots diagonally, owing to their tendency to twist and their different rates of speed, and after a while the cage also gives way or the roller twists around so far as to bind and break. When this happens, the bearing is not only disabled, but sometimes the axle and hub are so injured as to require replacement or, at least, repair. A second evil is the rubbing of the rollers on the cages, causing a loss of power, and, to prevent the consequent squeaking and heating, proper lubrication is necessary.

Attempts have been made to secure an adjustable roller bearing. For this purpose rollers have been made in the form of cones, as shown in Fig. 4.

It will be noticed that the axes of the rollers, *o*, and the lines of the cup, *p*, and cone, *q*, forming the outer and inner races of the bearing, all converge to a single point, *r*. This secures the necessary result, namely, that the speed of the large ends of the rollers on the large circumference of the race shall be equal to the speed of the small ends of the rollers on the small circumference of the race. Such a bearing is difficult to construct accurately in large quantities, as is evident, and is therefore expensive. The cone upon which the rollers run is intended to be advanced into the bearing as it wears away or as the rollers wear.

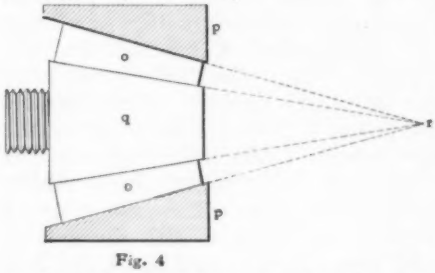


Fig. 4

In Fig. 5 is shown such a bearing, in which the cone is supposed to be considerably worn; the adjustment has forced

the rollers partially upon a fresh surface, and they do not rest upon their flat sides as intended. In this position the roller would soon become ruined. Moreover, the lines of the rollers and of the races have lost their converging features, and one end travels more rapidly than the other, causing it to veer around and to wear upon its supports or guides. The end of a bearing so adjusted would be but a matter of a short time if the wear on the conical race was sufficient to demand adjustment.

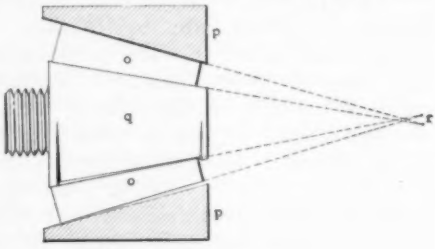


Fig. 5

For this reason the adjustable feature in roller bearings is believed to be of no value. If the bearing does not wear appreciably, no adjustment is necessary, and if it does wear, the adjustment does not remedy it, but, on the other hand, makes it worse.

As a matter of fact, the greatest wear upon a roller bearing of this kind is not upon the cone or rollers, for the wear of several thousand miles has been found so small as to be immeasurable. There is a material wear, however, upon the cage that holds them, and long before the rollers require any such adjustment as above noted, the cage has been disabled, and the rollers are no longer properly guided. So in this case, the adjustment theory has no chance to be favorably considered.

There is another serious obstacle in the way of using an adjustment for a roller bearing. While rollers, for all practical purposes, can be kept in their proper positions with a new cage, yet the slightest amount of loose motion in the cage, and the consequent slight displacement of the rollers which the cage allows, render it impossible to secure a tight roller bearing. There must be sufficient looseness in the bearing to allow the rollers to assume a slightly angular position on the axis. A thousandth of an inch is sufficient. The rollers, in assuming this slightly angular position with the axle, will require a larger diameter of hub than as if they were parallel with the axis at all times; hence in all roller bearings the race upon the hub should be slightly larger than required by the size of axle and rollers in a position parallel thereto.

The wearing action which is inseparable from rubbing surfaces, and which is rapid in roller cages, has caused the develop-

ment of a new controlling or guiding principle for the rollers. If rubbing can be eliminated from the controlling device, the wear due to rubbing will also be eliminated, and the bearing, if well constructed, becomes almost indestructible. Several attempts have been made to secure such a bearing.

The only bearing in which all rubbing has been successfully eliminated from the controlling device, as far as the writers

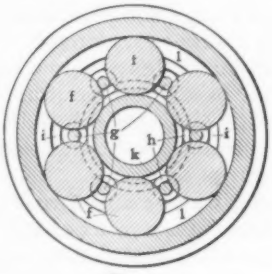


Fig. 6

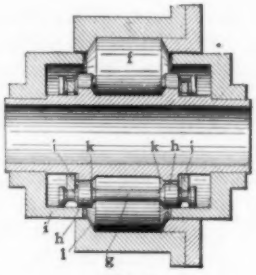


Fig. 7

know, is the "A. R. B." bearing, shown in the cuts, Figs. 6 and 7.

In this bearing the large rollers are separated by smaller separating rollers, *g*, mounted between the centres of the main rollers to prevent them from grinding on each other. The separators are so mounted at their ends that they *roll* upon their supports, *i*, *j*, without any rubbing or dragging; they have enlarged ends, *h*, overlapping the ends of the large rollers, as shown in Fig. 7, preventing them from twisting. These separating rollers cannot assume the position shown in Fig. 8 because of these enlarged ends, but are held in perfect alignment. All the rolling parts of this bearing are of hardened steel, and this, combined with the fact that there is no rubbing or dragging action, and that the rolling surface of a roller is equal to that on scores of balls, practically eliminates the element of wear. The absence of rubbing and dragging also renders the use of a lubricant unnecessary, except to prevent rust.

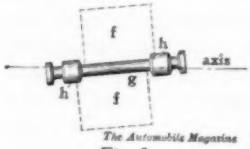


Fig. 8

In the ball bearing, the balls sustain weight upon points, and the lack of sufficient rolling surface causes them to wear away quickly; in the caged roller bearing, the rollers, while able to withstand the pressure upon their sides, rub against their cages and soon wear them

out, so that before long the rollers are no longer sufficiently confined, and soon bind and give way. In the "A. R. B." just considered, the rollers roll upon their separators, which in turn roll upon their supports, doing away with all rubbing, and hence eliminating all the consequent wear. The hardened steel separators and supports are simple and economical in construction, and are practically indestructible.

To secure an efficient rolling surface rollers should have generous diameters. The use of roller bearings will probably bring about larger hubs for a given weight than are now used. Road vehicles are subjected sometimes to such sharp blows on the wheel rims against a curbstone, a car rail, or stones, and often without the intermediation of the elastic tire, that the end-thrust bearing must be a stout one. The strains are momentary but effective in crushing a weak bearing.

In the "A. R. B.," above referred to, the end thrust is resisted by a bevel, against which the ends of the rollers roll. This is the principle of the bevelled car-wheel flange rolling against the rail, and of course its success is not open to discussion. The separating rollers are held in position and the main rollers held from twisting by similar bevels on the enlarged ends of the separators. Without rub, and its necessary friction and wear, without adjustment, with oiling only once in several months, and that to prevent rust, the "A. R. B." seems to have solved the bearing problem.

Electric Ignition by Dry Batteries

EVERY day electric ignition for gas-engines is gaining ground, and the time is not far distant when it will be generally employed, to the exclusion of ignition by burners. It presents so many advantages, offers so many facilities for quick starting, conduces so much to the easy controlling and running of the motor, that manufacturers who at first were its bitterest opponents are now adopting it one after another.

But these makers of motor carriages are confronted with an important question: What source of electricity should be employed—Should a generating armature rotating in the sphere of a magnet be used? or an accumulator? or a primary battery?

Experiments with the magneto-generator have not as yet yielded results of practical value. Hence there remain only the accumulators and the primary batteries to be considered;

and among the hundred of types of batteries which have been invented during the past century, the dry battery is the one which deserves the most attention.

Without detracting from the merits of the accumulator, for it undeniably possesses certain advantages so far as ignition is concerned, it would seem, from the automobilist's standpoint, rather than from the automobile-builder's, which is upon the whole the most rational view, that the dry battery is preferable to the accumulator. Those who have used accumulators know the inconveniences arising from their use. The plates are so exceedingly heavy, the internal short-circuitings cause such frequent stoppages, both at starting and on the road, the recharging of the battery is so tedious, and the acids will ooze out despite the care taken to seal the accumulators hermetically, that every automobilist has prayed for the introduction of some battery in which these faults were absent.

The dry battery has none of these disadvantages. If it be properly employed under normal conditions, if it be well made, if it be well arranged, if the material of which it is composed be carefully selected, the automobilist has at his command a source of electrical energy upon which he can rely with absolute certainty.

The only drawback to the use of dry batteries for ignition is the internal resistance of the cells which energize the primary of the induction coil (a resistance very great in comparison with that of an accumulator battery performing the same functions) and which has an influence on the character of the spark. The heat of the spark is not less intense; but for the same consumption of electrical energy in the primary coil it is smaller when dry batteries are employed than when accumulators are used.

The number of its points of contact with the explosive mixture is smaller, and the ignition is slower. That all this has very little effect on the operation of the motor is true enough; but that little is nevertheless perceptible. The influence of this internal resistance is greater as the consumption of electrical energy by the coil is less; and ignition by dry batteries necessitates the use of coils consuming as little energy as possible.

Many makers of cells have given their attention to this matter. Among them may be mentioned La Société Le Carbonne. Two years of experiment and constant trials have been crowned with success, and the battery now made by the Société is considerably more efficient than that made two years ago.

The Electric Automobile

By Prof. Félicien Michotte

THE electrically-driven carriage is generally known by one of two names—" electric carriage," by analogy with " steam-carriage," and " petroleum-carriage," or " electromobile," by analogy with automobile. Unfortunately, some electrician, with an incontrollable desire to display his cleverness, coined the word " accumobile," the meaning of which could be understood only if the steam-carriage were termed " boiler-carriage," and the petroleum-carriage " carbureter-carriage." Certain manufacturers have not stopped here, but have christened their vehicles " electrolabe," " electrobate," " velectra," etc. All this, no doubt, is well enough in its way; but it has the fault of being unintelligible and of leading the unwary to believe that there is something new where there is no novelty whatever.

THE OPERATION OF A CARRIAGE

Every electric carriage includes in its construction:

1. An electric motor;
2. An accumulator;
3. A transmission-gear;
4. A compound switch or circuit-controller.

The accumulator stores up electricity and supplies current to the electric motor through the medium of a distributer or switch. Under the influence of the current supplied the motor is made to turn at a great speed, developing power proportional to the electric current which it receives.

By adding a transmission gear, whereby the power developed by the motor is imparted to the wheels, we have a complete, operative, electric carriage.

Of all automobiles, the electric carriage is the simplest; for it does away with speed-changing gears, devices for throwing the parts into and out of gear, and requires only a mechanism for transmitting power to the wheels.

The electric motor can be driven at any desired speed; it is by far the cleanest of motors, evolves neither smoke nor smell, and is well-nigh noiseless in operation. The ease with which it can be controlled, coupled with the small amount of

care which it requires, leads us to the conclusion that it is the ideal motor for the automobile.

Disadvantages: Accompanying the merits which have been mentioned is a slight inconvenience—the sphere of action of

Electric Carriage, Showing Storage Battery

the electric carriage is limited; at the end of its run it must seek some source of electricity and recharge its accumulators. This disadvantage is minimized in a city where a carriage covers hardly more than forty miles a day, a distance which can easily be traversed with good accumulators of the Planté type.

MOTORS

The number of electric motors is large and is increasing every day. They differ chiefly in the form of the armature, in the number and arrangement of the field-magnets, and in the winding of the wire.

Since these matters concern chiefly the engineer, and since the *chauffeur* and automobile buyer can learn but little from a profound scientific explanation, I shall confine myself to the briefest possible description. The electric carriage constitutes a whole in itself, and its owner buys and values it on the strength of its running qualities. Each element, taken separately, tells nothing.

On the subject of electric motors I have only one statement to make, and that is on the weight of a motor. Often we hear a *chauffeur* remark: "My motor weighs only so many pounds." The weight of a motor is an entirely relative question; for, if the total weight of a carriage be three or four thousand pounds, it matters little whether a motor weigh twenty or even eighty pounds, more or less.

Certain motors which have been proposed make as many as 3,000 revolutions. Such high speeds are detrimental to the elasticity of the motor, render the transmission-gears more complicated, increase the weight, and tend to overheat the parts.

The tension of the motor-current is usually 80 volts, this potential being taken to facilitate the charging of the accumulators on 90 to 110 volt circuits.

The switch or circuit-controller varies both in construction and arrangement, but its purpose in all cases is the same. It serves to supply the motor with a definite amount of current in order to obtain the speed desired. To this device all the accumulator-wires run; and by its means the cells can be coupled in parallel or in series and made to supply the motor with all or only part of the current.

To diminish the current supplied to the motor, there are usually placed in the circuit resistance-coils, which consist of nickel wire, and which, by reason of their low conductivity, resist the current, absorb it, and convert it into heat. By means of the switch, one or more coils can be switched into the circuit, so as to decrease the amount of current supplied to the motor.

Motor with Parts Separated

Every carriage should be provided with a voltmeter and an ammeter. The latter may, at times, be dispensed with; but the former is necessary in regulating the charging of the accumulators.

TYPES OF ACCUMULATORS

Many are the kinds of accumulators in use; and their number, like that of the motors, is constantly increasing. Most of these varieties are largely modifications of previously existing types; and the rest, batteries discarded fifteen years ago and now brought forth again under new names or as new foreign inventors.

All accumulators of the pasted oxid type are practically useless in automobilism, and all attempts at adopting them for use on motor carriages are vain. Celluloid and glass may be placed between the plates to retain the active material, but the active material refuses to be retained, and thereby impairs the perfect operation of the accumulator, shortens its life, and aids in its rapid deterioration.

Lead accumulators of the Planté type are the only batteries which should be employed; but here again discrimination must be used. Certain accumulators are admirable for the purposes of buildings, but, owing to the nature of their construction and their small capacity, cannot be used in automobiles. The entire problem of devising a practical form of electric traction depends for its solution upon the invention of a practical accumulator.

To be practical, one should be economical; and a pasted oxid battery, at best, is serviceable only for 2,500 to 3,000 miles, assuming that the active material is retained and that there will be no short-circuiting. Even at the maximum figure, 3,000 miles, which in practice frequently becomes reduced to 600, there is no economy in using a pasted accumulator. A battery costs $400; and the running expenses would therefore be thirteen cents per mile, without counting the cost of maintenance. A private carriage covering twenty miles per day or a public cab covering 40 miles would respectively cost $2.60 and $5.20 per day. Certain makers claim that the running expenses of their accumulators will not exceed 75 cents or $1 per day; but even at these figures I doubt whether the system be of any practical value for automobiles.

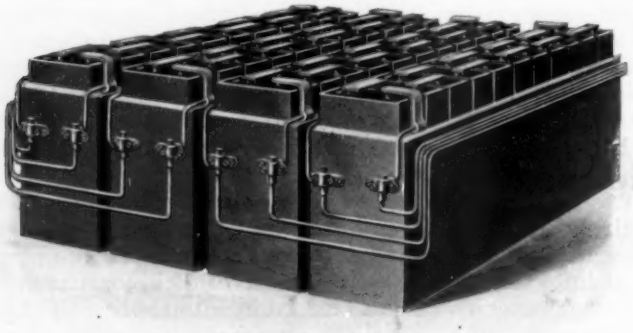
If, on the other hand, we consider the Planté battery, we shall see how great is its advantage over the pasted accumulator. A good Planté battery, when used every day, will last from three to five years. The distance covered for the three years at the rate of thirty miles per day will be approximately

$$350 \times 3 \times 30 = 31500 \text{ miles.}$$

The battery costs less than its pasted rival; but even at the price above given ($400) the cost per mile will be only

$$\frac{400}{31500} = \$0.01.$$

If the life of the accumulator be double that assumed, the cost per mile would be only one-half a cent. At the rate of one cent per mile, the daily running expenses in the examples previously given would be twenty cents for twenty miles in the case of the private carriage, and forty cents for forty miles in that of the public cab. These calculations certainly speak for themselves.



A Storage Battery

ACCUMULATOR BATTERIES

The accumulator battery is composed of a sufficient number of elements to correspond with the voltage of the motor, each element being equivalent to two volts, and the total number of elements being increased by 4. If the voltage of a motor be 60, then

$$\frac{60}{2} = 30$$

plus the 4 additional elements, or 34 elements will be required. For 80 volts, 44 elements will be necessary.

The battery is inclosed in a casing, the interior of which has been tarred. The elements should be separated from one another at least 3 to 5 mm. (.12 to .20 in.); and between adjacent elements insulating rods should be placed.

The accumulators of electric vehicles should always be enclosed in ebonite casings; celluloid should never be used, despite its lower cost and lighter weight. There is not a single maker of celluloid casings who has not one or two accidents on his conscience. Even cars are sometimes set on fire, proving that they, too, are endangered by the use of celluloid in cells. These accidents are due to short-circuiting.

The casings are usually closed either by an ebonite cover or by an insulating layer of some paraffin compound.

THE CHARGING OF ACCUMULATORS

Accumulators are charged at a constant potential, constant intensity, or constant wattage. The battery is charged at a constant potential when a constant voltage is maintained during the charging. The voltage can be read on the scale of the voltmeter, and by turning the handle of the switch in the proper direction a suitable number of resistance-coils can be thrown into and out of the circuit to secure the constancy desired. The voltage of the current should be equal to $2\frac{1}{2}$ times the number of elements. Thus, for 44 elements there will be

$$44 \times 2.5 = 110 \text{ volts.}$$

The intensity is constant when the ampèrage is constant. The power is constant when the number of watts is constant.

In charging accumulators a number of special devices are used, which are usually mounted on a single board. These devices comprise:

A voltmeter;
An ammeter;
A resistance-box or rheostat;
A switch by means of which the resistance can be varied;
A circuit-breaker;
Automatic cut-outs.

When charging at a constant wattage another special apparatus—a wattmeter—is added. These various appliances should be mounted preferably on marble or slate; or else the rheostat should be set up away from the board.

The rheostat serves to regulate the current in order to obtain the intensity desired.

The circuit-breaker is designed automatically to break the circuit, when, owing to a diminution in the intensity of the charging current, the accumulators will tend to discharge into the source of electricity.

The cut-out is composed of leaden wires, which will melt and break the circuit when the intensity of the current passes a certain maximum point.

The voltmeter and ammeter are instruments of electrical measurement.

CHARGING PRECAUTIONS

In charging accumulators, whether they remain in the carriage or whether they be removed, care should be taken that they be placed where air can circulate through the cells so as to avoid the corrosive action of the vapors arising from the acid solution as the charging nears its end.

If the accumulators be charged while still on the carriage, the casing of the battery should be entirely opened.

The density of the electrolyte, measured by an acidimeter, should remain constant, and the liquid should be tested from time to time. If the liquid be too concentrated, water should be poured in *after charging;* if the density be too small, acid should be added.*

The accumulators are charged by a current, the voltage of which is slightly higher than that of the battery. For a battery of 44 elements the voltage should be

$$44 \times 2.5 = 110 \text{ volts.}$$

If the voltage on the circuit used be too high, the resistance-coils will bring it down to the desired figure.

The time required for charging varies with the intensity of the charging-current.

With pasted oxid accumulators, the time is limited to a number of ampères per kilo of the accumulators (about one ampère); with lead accumulators three or four ampères per kilo is the ratio, the time for charging being thereby reduced to two or three hours for 10 and 12 kilos. As a general rule, it is preferable not to force the charging for the Planté battery, but to proceed slowly at a rate of two to three ampères.

* The acid used is sulfuric acid (20° Beaumé), commonly known as vitriol. It is extremely dangerous and should be handled with the utmost care, since it burns the flesh and the clothes. Should the acid come in contact with the fingers, the hands should be immediately plunged in water. The presence of the acid can be detected by its oiliness, and by the tingling, burning sensation which it produces. Acid-stained or burnt clothes should be neutralized by ammonia. The acid should be kept only in carefully-labelled glass receptacles. Never pour the water into the acid; but pour the acid into the water in a thin stream. The water used, it should be remarked, must be pure. Distilled water should be employed, if possible; but if it cannot be readily obtained, recourse must be had to spring or rain water.

The end of the charging process can be determined by:

1. The voltage.
2. "Boiling."

VOLTAGE.—When the voltage is equal to the number of elements multiplied by 2.4, the charging is nearing its end. For 44 elements we should therefore obtain

$$44 \times 2.4 = 105 \text{ volts.}$$

"BOILING."—The term "boiling" does not indicate a rise in temperature of a battery, but rather the great evolution of gas which occurs when a cell is nearly charged, numerous small bubbles rising and congregating at the surface. As the charging progresses, the boiling increases in violence, until finally the liquid is covered with a layer of small bubbles.

When a solid layer of bubbles, as it were, extends over the liquid in the cells, it is impossible to perceive the boiling. But the sound produced can be distinctly heard. After a little experience it can readily be determined, when the charging has been completed, if a voltmeter be not at hand, merely by the boiling.

In order to drive a carriage, the cells need not necessarily be charged to their full capacity. If the automobilist be pressed for time, he can charge his accumulators sufficiently to cover the distance still to be run. A battery can be slightly charged in ten, fifteen, or thirty minutes. If the time for charging the battery completely be known, and likewise the distance which can be covered at that charge, then the time necessary for charging the cells with an amount of current equivalent to the distance still to be run can be easily calculated, if the intensity of the charging current be known.

(*To be concluded in next issue.*)

AUTOMOBILE STREET-CARS

The Siemens & Halske Company, of Chicago, has announced that it will introduce the Berlin system of autocabs in that city. These cars carry about twenty-five passengers, and can run on either street-car tracks or a paved roadway. They will be operated by storage batteries. C. S. Knight, vice-president of the company, states that the plant in Chicago will be enlarged for the construction of the busses and the work begun as soon as the great demand for private automobiles slackens.

The Fritscher-Houdry Petroleum Motor

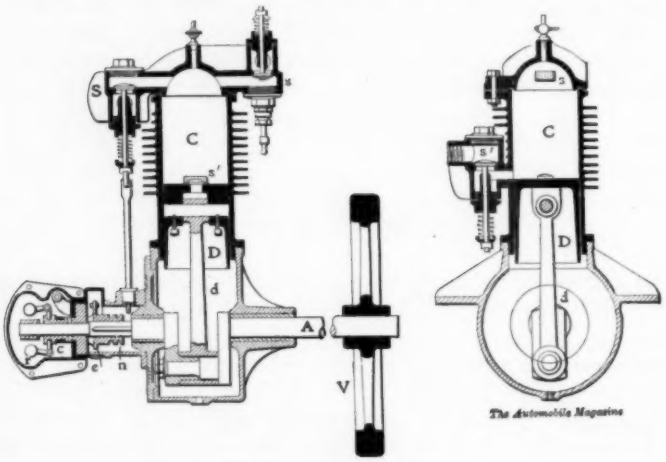
ONE of the most remarkable engines of its kind—remarkable chiefly for its ability to withstand the severest tests to which it can be subjected—is the four-cycle petroleum-motor invented by Fritscher and Houdry.

At the Exposition des Tuileries, the motor ran continuously from nine o'clock until twelve, and from two o'clock until six, without the slightest noise, and without any sign of being overheated.

In our illustrations representing the motor in side and end elevation and in perspective, the cylinder C is surrounded by cooling-flanges, and incloses the piston D, to which is pivoted the piston-rod *d*, connected by a crank with the shaft A, provided with the fly-wheel V.

The motive agent, after having been carburetted in a vaporizing-chamber of a peculiar construction devised by Fritscher and Houdry, is injected in proper quantities into the cylinder, after each stroke of the piston. The motor starts almost immediately after the shaft has been turned a few times.

The explosive mixture is admitted by the automatic valve *s*,



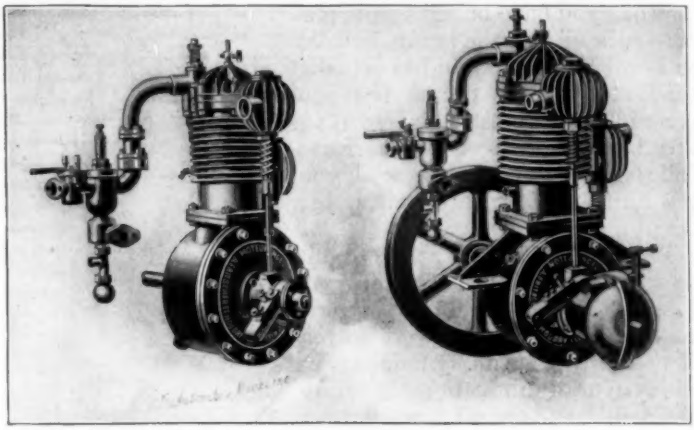
Side and End Elevations

and is ignited by an electric spark. The exploded gases are discharged through two openings:

1. An automatic valve *s'*, located at the end of the down-stroke of the piston.

2. A mechanically operated valve S, through which the residual gases are discharged on the return stroke of the piston.

By reason of this arrangement the hottest gases are exhausted first, at the end of the third period; while the gases discharged through the upper valve S are considerably cooled, from which it follows that the valve cannot become overheated.



The Fritscher-Houdry—Perspective View

The valve S is operated by the rotation of a double-grooved sleeve *n*, which turns with the shaft A. If the speed of the shaft A be excessive, the sleeve and its auxiliary collar *c* will be displaced from their normal position by the action of the governor *r*, as its balls are thrown outward; and the grooves being out of engagement with the valve-stem, the valve S will be closed. The electric spark is produced by means of the cam *e*; the ignition can take place at any desired interval.

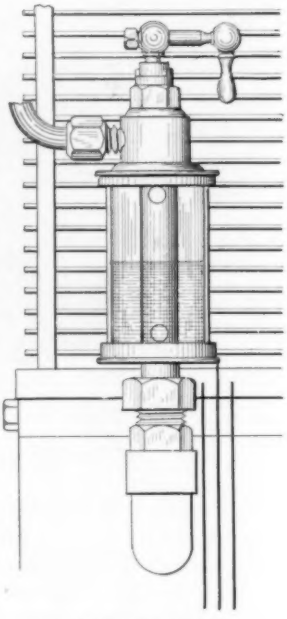
The one and two horse-power motors have their fly-wheels mounted within the casing, and are not provided with governors. The three horse-power motors (weight 210 lbs., for light carriages) are furnished with a governor and a fly-wheel on the exterior.

A New Sight-Feed Lubricator

WHEN the oil-reservoir of a motor contains a pump for injecting the oil into the cylinder or other parts, the feeding of the oil can be effected without soiling the clothes and without loss of time. You pull up the piston, you push it down again, and the thing is done. It is quick—but it is not certain.

When you have pulled up the piston to suck oil into the pump, how do you know that the liquid has actually risen? Nine times out of ten you have sucked up mostly air; so that, instead of supplying a full measure of oil to the part to be lubricated, you have furnished it with only half the desired quantity.

To remedy this defect there is but one way—to render the quantity of oil which is fed visible. Messrs. Desponts and Godefroy have solved this problem very simply indeed. In their system of lubrication the pump is discarded, and the oil flows directly by gravity from the reservoir in which it is contained to the lubricator gage. This lubricator is made of thick glass, and contains exactly one measure of oil; the automobilist can, therefore, readily see the amount of oil fed.



Sight-Feed Lubricator

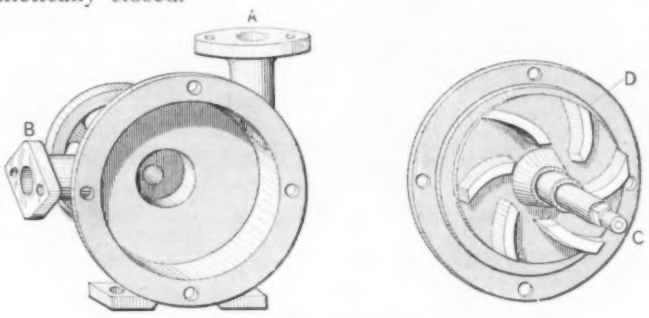
The lubricator is so constructed that the same operation which permits the oil to flow closes the passage which leads from the reservoir to the liquid, and vice versa.

This light and neat little device, which has the great merit of dispensing with the untrustworthy oil-pump, seems one of the most practical forms of lubricators yet invented for use on automobiles.

A Simple Water-Circulating Pump

IN order that the cylinder of a motor may be effectively cooled, the water must evidently be circulated rapidly and trustworthily. The thermo-siphon system long used in many stationary engines has been found inadequate for automobile motors; and it was therefore necessary to employ circulating tubes or pipes, which connected the motor with the cooler, a small pump driven by the motor being used to force the water constantly through the pipes.

In an automobile, the parts of which are in themselves already complicated, it was, of course, impossible to employ a reciprocating pump. For the use of such a pump with its valves and joints would have added another source of accident. The centrifugal pump, on the other hand, has no valves, and its joints can be hermetically closed.



Water-Circulating Pump

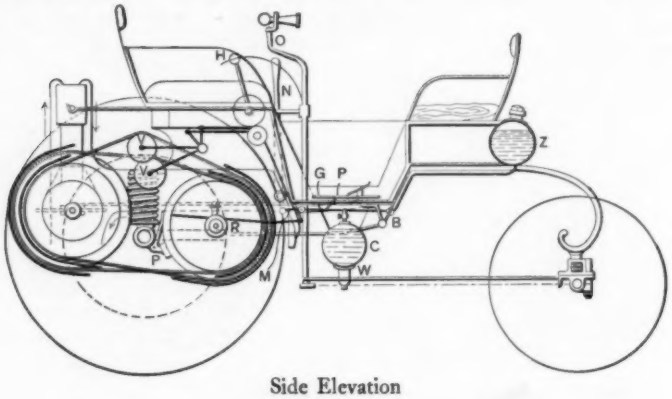
We present herewith an illustration of a simple centrifugal pump made by Messrs. Dalifol and Thomas, which has been especially devised for use upon automobiles. Our engraving shows the pump with its parts separated. It is evident that the construction is the simplest conceivable. In the body of the pump the disk D is mounted, which disk is provided with radial curved blades, by which the water is forced out. This disk D, which is essentially a turbine-wheel, is given a rotary movement by means of the pulley B driven by a belt or by friction with the fly-wheel of the motor.

The chief merit possessed by this pump is the facility with which it performs its functions without in any way affecting the pipes which project from the pump-body at A and B. The disk C can be removed by unscrewing the four bolts by which it is held in place.

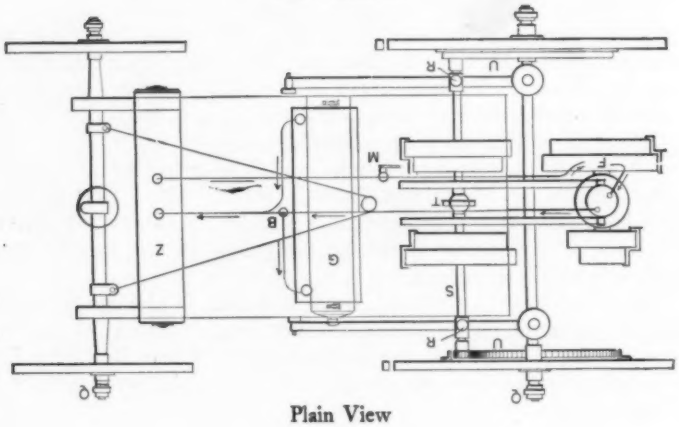
The Daimler Carriage

By D. Farman

AS a result of the collaboration of Europe's two most famous automobile inventors, E. Levassor and G. Daimler, a new motor for horseless carriages has been devised, which is a modification of the celebrated Daimler motor. Although they succeeded in producing the new "Phœnix Daimler" motor, the two inventors could not agree on the method of transmitting the power to the driving-wheels. Levassor adopted the



Side Elevation



Plain View

sprocket and chain; but Daimler insisted upon the use of pulleys and belts in the speed-changing gear, and of gearing in the transmission of power. It was, however, agreed that the system which gave the best results was finally to be adopted.

But the death of Levassor cut short further experiment; and Daimler retained the belt-and-pulley system which he has used with such gratifying success on his own carriages.

In the above illustrations we have represented in side elevation and plan the motor and operative mechanism of the improved Daimler carriage.

The "Phœnix" motor is arranged in the rear portion of the carriage, and is provided at each side with two pulleys, which also serve as fly-wheels. Four other pulleys are keyed on the shaft, *S*, of the differential gear, which is connected with the rear wheels of the carriage by means of two pinions, *R*, and gear-wheels, *U*. The driving-mechanism and the speed-changing gear consist essentially of belts running over the four pulleys of the motor and the differential gear. By manipulating the lever, *H*, controlling the tightening-pulleys, *V*, the desired speed is obtained. By the employment of belts running over the tightening-pulleys the carriage can be gently started and silently driven.

The motor and the burners are supplied from a common petroleum-reservoir, *Z*.

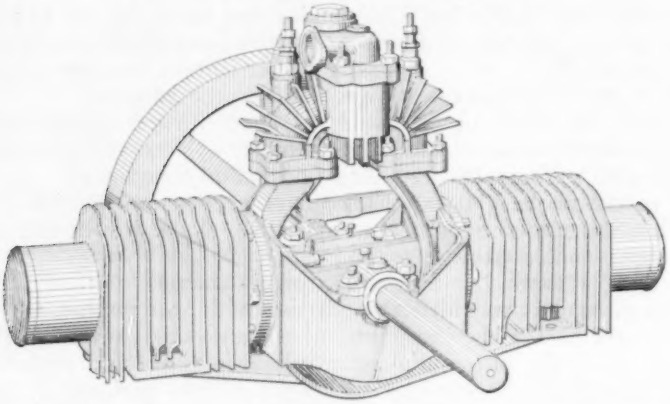
The front axle is swivelled at its centre and is controlled by means of a chain-gear operated by the crank-handle, *O*. The lever, *N*, commands the brake-shoes of the wheels, and the pedal, *P*, controls the brakes of the differential gear.

The Doré Motor

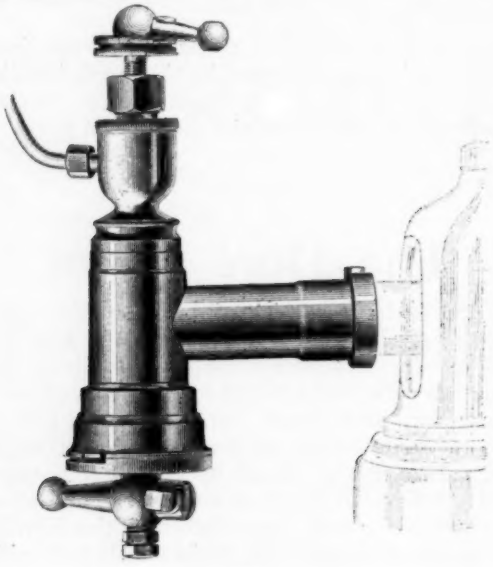
A MOTOR which was recently exhibited by Doré & Co., at the Tuileries, in Paris, shows not a little progress in construction. Its chief merit is its simplicity; since, but a single-admission valve and a single-exhaust valve have been provided. There is no back thrust, no complicated gear to operate the exhaust-valve, no cooling of the motor by circulating water.

Another advantage obtained by the novel construction is lightness; for a five-horse-power motor weighs but 92 pounds without the fly-wheels, and 165 pounds with the fly-wheels.

One of our illustrations pictures the carbureter which is used



in connection with the motor. Besides its efficiency of operation, the carbureter possesses the additional merits of being simple in construction, small in size and weight, and is applicable to the motor of any motocycle, tricycle, or motor-carriage. Under all circumstances it will operate uniformly in conjunction with the motor; and its form is such that it may be mounted in any place that may be convenient.

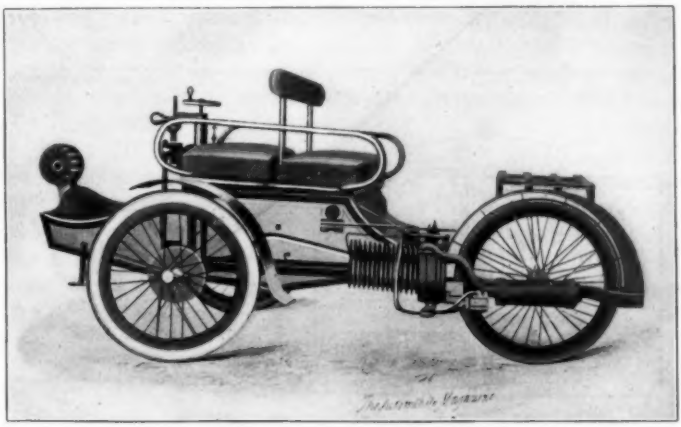


The Py Motor-Carriage

AMONG the carriages which attracted much attention at the last French automobile exposition may be mentioned a vehicle made by the Compagnie des Automobiles du Sud-Ouest, and invented by M. André Py, the manager of the company.

The Py carriage, which is represented in the accompanying illustrations in perspective, longitudinal section, and plan, is noteworthy for its handsome appearance and roominess, and for the simplicity of its mechanism.

The motor is a one-cylinder, four-cycle engine horizontally mounted at C, somewhat to the rear of the vehicle and to one side, so that its piston-rod can readily drive the crank *v*. The crank is secured to the end of the piston-rod, which is made in



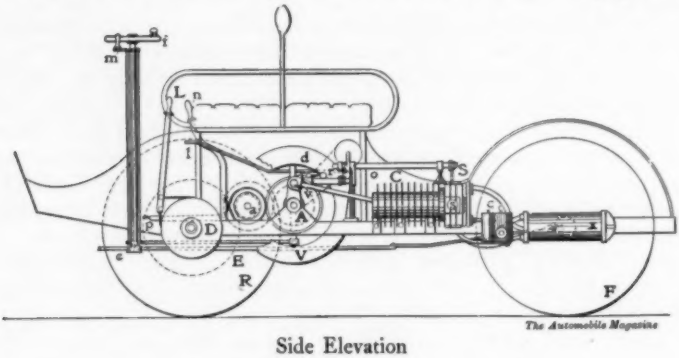
The André Py Carriage—Perspective

two pieces held together by a steel collar. The explosive mixture of vapor and air passes from the carbureter *c*, through the automatic admission-valve *s*, and is discharged either by an ignition-tube or by an electric spark. At the end of the cycle, the exploded gases are discharged through the exhaust-muffle, situated in the rear of the carriage to one side.

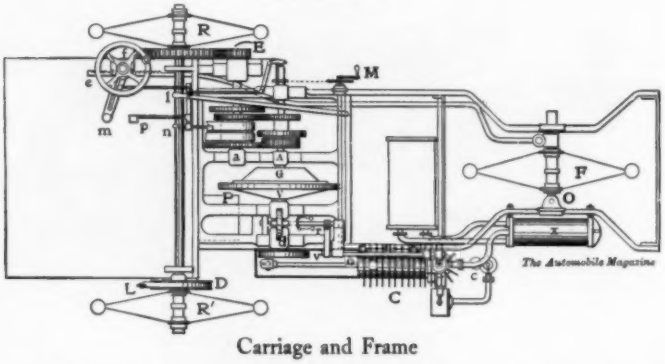
The exhaust-valve S for the exploded gases is operated by a small shaft *o*, driven by the worm-wheel *d*, which receives its

motion from the shaft A. The ball-governor *r* connected with this shaft is an exceedingly sensitive device which controls the valve *S*.

The fly-wheel V, secured to the shaft A, transmits the motive power to the driving mechanism by means of a friction-clutch G. This mechanism comprises two trains of gear-wheels so connected that the wheels and pinions, suitably secured to the motor-shaft A and to the auxiliary shaft *a*, are thrown into engagement



Side Elevation



Carriage and Frame

to obtain three different speeds—five, eleven, and eighteen miles per hour. This last speed can be increased to twenty-two miles by driving the motor at its maximum speed. The carriage can be driven backwards by manipulating the reversing-lever *l*.

Power is directly transmitted to the axle of the front driving-wheels R and R′ by a gear-wheel E on the right-hand side. A differential gear A, provided with a friction-brake, is located at D, and is controlled by means of a lever L.

All this mechanism is inclosed in a box or casing beneath the double seat of the carriage. The two seats being hinged, the various parts can be readily inspected, adjusted, and lubricated. This box also contains the petroleum-reservoir P, with a capacity of nearly three gallons—a quantity of petroleum which will enable the carriage to run 112 miles on an ordinary road.

The crank-wheel M, by means of which the motor is started, is one of the most efficient devices of its kind. A single turn of the wheel will set the engine in motion, the same movement simultaneously operating the escape-valve. By grasping the handle M firmly, the entire wheel can be immediately removed.

The carriage is steered by the rear wheel F, the steering mechanism being operated by the hand-wheel *f*, connected with the rack *e*, through the medium of which the axle of the wheel F is turned about its pivot O. By operating the brake of the differential gear D, the carriage can be turned within a circle the diameter of which is sixteen feet.

M. André Py has practically built a two-wheeled carriage, since the wheel F serves merely as a support and steering-wheel. The motor develops exactly 3.6 horse-power, the efficiency being 80 per cent. at the wheel-rim. With a load of over 600 pounds, grades of 10 and 12 per cent. have been ascended with a feeble motor.

The total length of the carriage is nine feet; the width between the wheels R and R′, 4.65 feet. The seats are placed not quite four feet from the ground, by reason of which position, and of the arrangement of the motor and operating mechanism, the centre of gravity is very low, thereby rendering the carriage exceedingly stable. By the addition of a top, the appearance of the carriage can be still further improved.

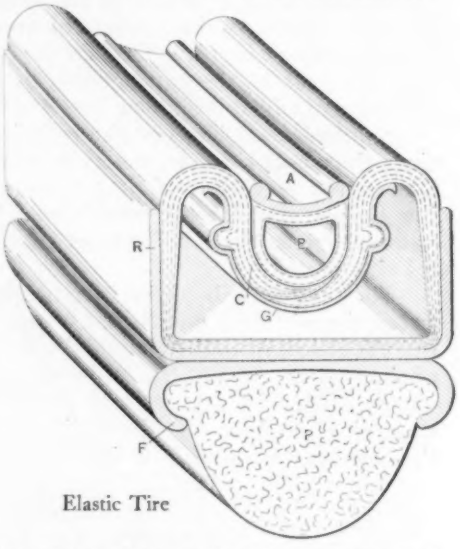
AUTO-CAR TIRES

The fact that many owners of private motor-carriages in England still use solid rubber tires is a source of continual wonderment to Continental *chauffeurs*. The advantages, as regards comfort, absence of noise and jarring, safety in case of running over an obstacle, and the absorption of vibration which would otherwise be conveyed to the engine, are so great as to entirely outweigh any objection on the ground of puncture. Moreover, punctures are comparatively few in the case of carriages fitted with large tires of at least four or five inches diameter.—*London Daily Mail.*

A New Tire for Motor-Carriages

THE provision of a tire which would meet all the requirements of a motor-carriage has long engaged the attention of automobile makers. The problem, which at first sight seems one of no great moment, is worthy of no little consideration; for, if the tires be good, the motor will run more easily, and the life of the mechanism will be greatly prolonged.

Owing to the inadequacy of springs, the wheels have been provided with elastic tires, which were at first of solid rubber, and, later, pneumatic. When it was found that the solid rubber tire did not meet all requirements, the manufacturers of automobiles had recourse to the pneumatic tire, which, although undeniably superior to solid rubber, has many disadvantages, chief among which may be mentioned the danger of its being punctured. It has therefore been the aim of many inventors to devise a tire which should possess all the merits of the pneumatic tire without its faults. The tire which forms the subject of the accompanying engraving has been designed with this end in view.



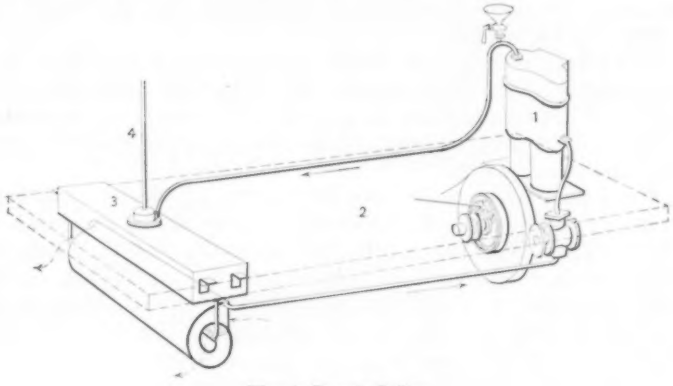
Elastic Tire

It will be observed that the tread of the wheel is composed of solid rubber *P*, held in a rim *F*. But this rim *F* is connected with the spokes by means of a removable pneumatic tire. The outer wall of the air-chamber is protected by an auxiliary rim *R*, and its extremities are overlapped at *C* and held in place by a half-tube *G* of steel. The extremities *C* are hermetically forced into contact with each other and with the tube *G* by means of a small elastic tube *D* secured to the rim *A* of the spokes. This tire evidently has the advantage of not being readily punctured. Its weight is probably considerable, for there are no less than four steel rims included in its construction.

Benoit-Julien Water-Cooler

EVERY automobilist knows what a difficult problem it is to cool the water which has circulated in the jacket of the motor for preventing the overheating of the explosion-chamber, and properly to arrange the pump which produces this circulation.

The problem seems to have been solved in a system devised by Messrs. Benoit & Julien, in which, as may be seen from the accompanying diagram, the principal elements are:



Truck Benoit-Julien

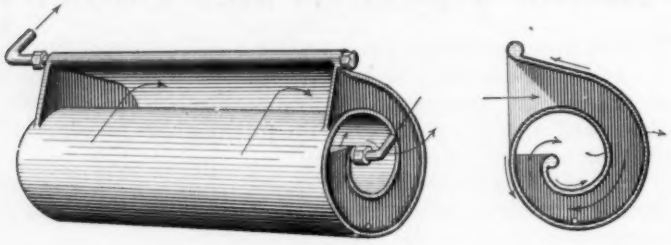
1. A motor having a double jacket.
2. A friction-clutch of the Julien type.
3. A rotary Benoit-Julien pump.
4. A Julien water-cooler surmounted by a water-tank.

The Benoit-Julien pump comprises a cylindrical body, closed at each end by two heads. Within the cylinder a screw is mounted, having a right and left thread, separated by a straight partition on the shaft. At a speed of 2,000 to 4,000 revolutions per minute, the pump can discharge 110 to 132 gallons per hour, the difference of level being 3.28 feet. With this pump water can be easily raised from a depth of two feet.

The two annexed views represent the Julien water-cooler in perspective and in cross-section.

The water-cooler is essentially a spiral tube in which the water to be cooled circulates in the form of a sheet 0.12 inch

thick and 4.10 square feet in area. When it is considered how thin is the surrounding envelope (it is only 0.02 inch thick), and



how large the cooling surface, it is evident that the water can be very quickly cooled.

The effectiveness with which this apparatus serves its purpose enables a water-tank of small capacity to be employed. The tank could even be entirely dispensed with, were it not necessary to keep it in reserve for losses occasioned by leakage at the pipe-joints and other places.

The Julien water-cooler can be secured by means of its inlet and outlet pipes under the water-tank, either in the front or rear of the carriage, with its mouth directed to the front. When the carriage is in motion the air is received by the mouth of the cooler and, after having circulated through the interior, is allowed to escape through lateral openings. The exterior surface is similarly acted upon by the air. The cooler can also be hung from iron supports secured to the heads A.

Mud does not readily cling to the cooler; but should it do so, it can be readily washed away, the water running off through small holes in the lower portion of the heads.

DOCTORS AND AUTOMOBILES

Take the case of a doctor in the country with a large and scattered practice. Four to six horses, a couple of men, stabling, shoeing, forage, wages, repairs, vets' bills, etc., will cost him at least £300 a year. A motor car, on the other hand, after the first initial expenses (they vary in price from 150 to 300 guineas) only requires the services of a lad to keep it clean, and it will cost considerably under £100 a year, including wages, repairs, and the fuel or motor power required.—*British Medical Journal.*

The Automobile
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Editorial Comment

THE TRANSITION

IT is just twenty-seven years since there swept around the world a mysterious malady that universally attacked the equine species. Horses everywhere were sick and unable to work. The disease seemed to sap their strength completely. Very few horses were exempt from the attack. For the time that it lasted business was almost paralyzed. In city and country, wherever horses were depended upon, transportation was almost entirely suspended. Ox teams were brought into the towns, and their services commanded great prices. Horse-car and omnibus traffic was at a standstill. In some cities the strange spectacle would be seen of a horse-car passing at rare intervals and hauled by men through the streets, carrying passengers to and from suburban places at twenty-five cents a fare; the employees of the company taking advantage of the opportunity to earn something, at least, in the period of their compulsory idleness. They dragged the cars by ropes, just as men used to drag the hand engines to a fire in the old days, and they made something of a lark of the event. The silence of the streets was that of rustic highways; it seemed oppressive, coming as an interlude in the customary Babel of urban noise; but, could our cities become permanently like that, the almost heavenly peace would be unspeakably welcome. A disastrous result of

the epidemic was the great fire in Boston that destroyed the greater part of the business section, for the fire-department horses were sick, and there was a fatal delay in getting the engines to the spot.

It would have required but a comparatively slight intensification of the malady to make it fatal, sweeping every horse from the face of the planet. In all probability, not a few of the strange species that existed in prehistoric ages, as witnessed by their fossil remains scattered throughout the bosom of the earth, were annihilated by similar causes. We are not aware if the epizootic, as the epidemic of 1872 was called, ever before raged through the world. But there is no reason why it should not again occur. Suppose that it should? The industrial harm would now be far greater than then, for civilization has extended itself enormously in the past quarter of a century, opening up vast new regions to occupancy in all parts of the world. Its recurrence would unquestionably give a great impetus to the automobile movement, for it would impress men's minds with the desirability of taking quick advantage of the substitute at hand. But suppose that an intensification of the malady should occur this time! Suppose that, in the course of one short month, every horse in the world should pass out of existence! Not even the most impassioned friend of the automobile could wish for such a consummation. For it would mean a world-wide catastrophe of a most appalling nature. Doubtless human ingenuity would speedily devise a way out, and civilization would adapt itself to the new conditions. New methods of transportation would be hastily improvised, not only for those parts of the world where there are passable roads, but for the roughest and wildest of regions. An enormous leap forward in new inventions to these ends would be made. Practically all the energies of civilized society would be bent to the one great task of installing new forms of burden-bearing mechanism. But meanwhile there would be famine and pestilence to an unheard-of extent. In consequence there might ensue such an enfeebling of the race, such a sapping of the resources of civilization, that recovery would be exceedingly gradual. Therefore the improvement in transit methods would be obtained at a fearful price.

It should be remembered that animate instrumentalities, guided as they are by inherent intelligence trained to certain definite ends, are so flexible, so adaptable to widely varied uses, that to expect to replace entirely by mechanical substitutes a creature like the horse would be much like expecting to replace

the human hand by mechanical devices. Hence, while efficiency is enormously increased in those functions where machinery replaces animate instrumentalities, there must remain a large class of operations where, for intricacy and delicacy of manipulation, the former must be retained. Therefore for a long time to come the horse will remain indispensable for a variety of uses. And even should he disappear, there would remain other beasts of burden whose use might be extended and developed to good advantage. For example, there is the trusty, though slow-going, ox; the plodding and patient donkey, cousin to the horse, so universal in Mexico and other Spanish-speaking lands; his other cousin, the zebra, the elephant and the camel; the ruminant llama of the Andes, industrious little brother to the camel; and even the humble dog, usefully earning his living in many European countries as well as in the polar and Arctic regions, where the reindeer likewise serves in harness. The utilization of many of these animals might greatly be extended, if demanded, and since most of them are without such a sensitive organization as the horse, with his tendency to insane panic, they could better serve side by side with the automobile, on more friendly terms with the latter. Man, too—the more's the pity—acts as a very efficient burden-bearing animal in many parts of the world.

The transition to the era of mechanical traction, now well under way, is hardly likely, however, to be accelerated by any sudden or dramatic happening. The change, though it will proceed with ever-increasing momentum, will nevertheless be gradual, until we find the horse replaced in the main fields of his activity throughout the populous parts of the civilized world. The process will probably be very similar in its course to that which has taken place within the past decade in the substitution of electric for animal traction on our street railways. Ten years ago electric traction had just begun to pass out of its experimental stages. It was tried here and there in minor localities, and then the great company that had acquired the street-railway systems of Boston began with changing over two of its lines. Trial on such a scale gradually showed various obstacles to be overcome and various improvements to be made; the old plant was made available for awhile in many respects, but very soon the tracks had to be entirely relaid with heavy rails, the small and light cars had to be replaced with larger and stronger ones, and it was not long before the entire plant had been replaced in almost every part by a new and far more costly one, with great additions and extensions. In all the other great cities of

the country the same thing soon took place. The advantages of the new methods also caused an enormous extension of electric street railways throughout rural parts, affecting the life and the habits of a great portion of the country's population to a profound degree. So, in a very few years, we have seen this movement in a single phase of the transit problem effect a most significant revolution, building up great industries and creating new sources and forms of wealth that mount into the millions and millions in the aggregate, with far-reaching social and industrial consequences.

We are now witnessing the beginnings of a far greater change in transit instrumentalities—a change that is destined to bring about not a few remarkable innovations. Already most powerful combinations of capital are engaged in the work, but the industrial activity which the movement will cause will make present operations, great as they are, seem slight in comparison. Great manufacturing establishments are straining all their facilities to keep up with the demand, but soon we shall see not only practically every carriage-making concern in the country devoting its main energies to automobile work, but additions made to existing plants that greatly increase their capacity, and many extensive new factories built for the purpose. The bicycle manufacturing industry, extensive as it has become, is small in comparison to the industrial operations that the development of the automobile will entail.

The organization of cab services in the large cities is one of the most important aspects to occupy the energies of those engaged in the field. Side by side with this work will be that of supplying the large demand for domestic and pleasure purposes, in the way of light vehicles, ranging from victorias, buggies, runabouts, etc., down to motor cycles. The establishment of omnibus lines in the cities, after the example set by the electric omnibus service soon to be installed in Fifth Avenue, New York, will naturally follow the motor-cab movement, and the principle will soon be applied to all forms of cartage—trucks, wagons, etc.—until the middle of the first decade of the twentieth century will be likely to see the vehicular traffic of our cities almost entirely transformed, with the movement also ascendant throughout the rural parts of the country, wherever the condition of the roads will permit it.

Just as we have seen the street railway tracks reconstructed to meet the demands of electric traction, so we shall see a very general reconstruction of the highways, both city streets and country roads, to meet the changed conditions imposed by au-

tomobile requirements. New features will doubtless be introduced of which we at present have scarcely an inkling, and the department of road-engineering will become one of the most important and most extensively practised branches of the engineering profession. Good roads will become universal in parts of the country where good roads are wholly unknown at present; and the revival of country inns to cater to the renewed use of the highways for travel, already extensively promoted by the popularity of the bicycle, will take place on every hand. The effect upon life in the country will be as marked and as beneficent as upon life in the city, and the social and industrial changes cannot fail to be very extensive throughout the world. It is a good time to live in!

Municipal Automobiles

The city of Boston has taken an advanced stand in relation to the use of the automobile for municipal purposes. The fire department has two automobile steam fire-engines in regular use. One of these has been doing excellent service for something like two years or so. It gave such thorough satisfaction that a second one was soon ordered. It is a thrilling spectacle to see these powerful machines rushing through the streets in response to an alarm of fire. An ordinary horse-drawn steam fire-engine is, however, sufficiently terror-inspiring in the elements of noise, so that the advent of the horseless machines does not seem to have contributed in any special degree to the agitation of the equine population of the city. In Mayor Quincy Boston has a chief magistrate who, like his two ancestral namesakes in the same office, takes a modern view of public affairs, and seeks the aid of all available instrumentalities of an improved nature in carrying on the city work. Owing to his initiative, two motor vehicles were ordered early in the present year for the use of officials in two of the administrative departments in going about their work in various parts of the city. One of these, a light steam-carriage, with seats for two persons, has been in use since the beginning of August, and proves to be equal to the work of at least three horses. It was intended for the use of the chief of the Repairs Division in the Public Buildings Department, who in the course of his duties has to make many trips to all parts of the city. But since, unlike a horse, it does not get tired, the automobile is available for other business of the department when not in use by the particular official in whose service it stands, and in this way a considerable economy is effected. This steam-carriage often does a turn of forty or

fifty miles a day within the limits of the regular working hours. It stands ready for use at any moment. It is proposed to try the various forms of motive power in the city work of Boston. The second automobile ordered is a gasoline-motor carriage, which, oddly enough, is assigned to the use of the superintendent of the Electrical Construction Department, instead of an electric carriage. As a very large number of horses are used by the various officials in going about their work in different parts of the city, the substitution of motor vehicles means a very considerable saving in expenditure and also a materially increased efficiency. There is a wide field for the automobile in municipal work, and should cities take a leading part in its introduction, as Boston appears to be doing, they will not only directly profit by the heightened efficiency in the operation of the various branches of municipal activity, but the example thus set will accelerate its general adoption. Therefore the consequent saving in the wear and tear of the highways, and the reduction in the cost of street-cleaning to a fractional part of existing outlays for the purpose, will effect an enormous diminution in heavy items of expenditure. This would set free large sums to be employed in reconstructing the streets with the most improved forms of pavement, smooth and noiseless, whose durability, when freed from the destructive action of horses' feet, would be vastly extended. Moreover, the saving would also enable cities to give more attention to those features of public utility which, although commonly considered as luxuries, are nevertheless indispensable to the equipment of a growing modern municipality—features such as parks, art galleries, tasteful public buildings, public baths, and other desirable improvements—many of which are considered beyond the means of the average municipality, sorely taxed as it is likely to be, but which would be made available in consequence of such economies. In the broad sense of the word, the municipal field for the application of the automobile transcends its use merely for transit purposes. The adoption of the automobile principle for steam fire-engines has been noted. The pioneer application of the principle, of course, was in the steam-roller, whose use has long been universal. There are other fields of mechanical work where its adoption will prove equally efficacious. One of these will be its application to street-sweeping purposes, and another in which it cannot fail to effect very great economies will be its employment for cartage purposes. We can look to inventive ingenuity to devise other forms of use in which the automobile will speedily take the place of animal traction in many other departments of municipal activity, greatly

to the benefit of all concerned. And not the least benefit will be that derived from the incalculable sanitary improvement that will come with the disappearance of stables from our cities and of horse excrement from our streets; as well as from the reduction of nervous maladies that will attend the abatement of street noises.

American Automobile Club

As a worthy successor to the famous Automobile Club of France and its offspring the Automobile Club of Great Britain and Ireland, an Automobile Club of America has now entered the lists of militant organizations that are speeding the world along its accelerated course toward the new era.

The club was definitely organized at the Waldorf-Astoria Hotel, in New York, last month, with a hundred charter members, including the thirty-five original founders. General Avery D. Andrews, of New York, accepted the presidency, to be aided by George F. Chamberlain, first vice-president; V. Everit Macy, treasurer, and Capt. Hedge, secretary.

The Automobile Club of America has been officially recognized as such by the Automobile Clubs of France and Great Britain. According to present plans the organization of the club will prove of immediate benefit to American automobilists, for steps have already been taken to conduct test runs and inaugurate an automobile exposition. This show will be the first of its kind in the Western Hemisphere, and is expected to surpass the horse show as a social event. A majority of the intending exhibitors will take their vehicles to the Paris Exposition.

Obituary

We regret to record the death of M. Louis-Victor Lockert, E.C.P., editor-in-chief of the Paris *Chauffeur*, a charter-member of the Automobile Club of France, as well as of the Touring Club of France, and the author of a series of well-known monographs on automobilism. M. Lockert, before his lamented death at the age of fifty-six, achieved a national reputation as one of the foremost expounders of modern engineering problems. He represented his country as Chief French Commissioner at the International Exposition at Moscow in 1872, and as commissioner of the national engineering exhibit at the Paris International Exposition of 1878. In recognition of his good services he was appointed a Chevalier of the Order of Saint Anna of Russia, and bore the decoration of Emperor Francis Joseph

of Austria. His burial in the grave-yard of Montmartre, last month, was attended by a number of the most prominent automobilists of Europe.

Electric Automobiles

OUR contemporary, *The Horseless Age*, appears to consider that it holds a brief against the electric automobile. A few weeks ago we pointed out the worthlessness of some "evidence" it had offered in support of its position that "electricity cannot compete with horses in public cab service." The current issue of that journal contains another attack on electric automobiles, this time based specifically upon the assumed worthlessness of the storage battery upon which they depend for motive power. In this instance again, there is an extraordinary jumble of inaccuracy and misinformation. For example, an early experiment with storage battery traction is referred to as follows: "At Washington, D. C., *a few years ago* most extensive and disastrous experiments were conducted on the Metropolitan Street Railroad, ending in the usual way with the resumption of horse-power." The italics are ours. For more than four years the road mentioned has been electrically equipped. The purely experimental Julien storage-battery car, run ten years or more ago in New York, is also referred to, but, of course, no mention is made of the Chicago & Englewood storage-battery road which has been in successful operation for several years, nor of the successful storage-battery lines in Paris and elsewhere abroad—foreign reference being confined to a single storage-battery car, said to be now running in England, whose operation is stated to cost 36 cents per car-mile!

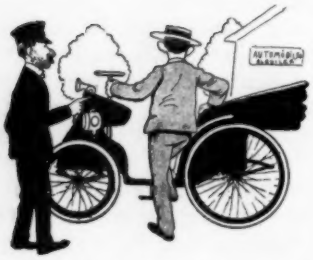
Among the specific charges against the storage battery are, that it has electrical and mechanical limitations; increased efficiency means greater weight, and decrease in weight lessens the efficiency and weakens the plates; the sulphuric acid in the cells must be kept at a uniform specific gravity; too rapid charging and discharging results in damage; and so on in a vein that might be similarly worked in an arraignment of the steam-engine or any of the imperfect product of the hand and mind of man. Again, we are told that the storage battery is a delicate subject even in stationary work, and that for cab and delivery service it is as often in the hospital as it is in service—for which reckless statement no proof is offered; that in traversing roads

that are rough and intersected by street-car tracks, the whole overloaded structure is racked, gears are thrown out of line, wheels are strained, and the power of the battery wasted. Strangely, there are a few words of favor for the electric automobile, it being said that its high cost, simplicity of control, and undeniable æsthetic features, commend it to the rich, especially to ladies, for urban use, and that it will undoubtedly find other incidental uses where the demands made upon it are light. Some may question the ethics of selecting ladies and the rich to be the victims of such an abomination as the electric automobile is portrayed.

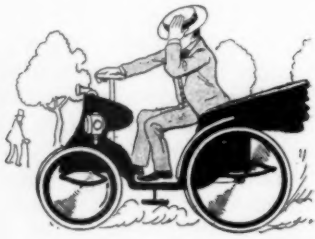
As our contemporary does not assume to have any technical knowledge of the storage battery, and apparently quotes merely at random in its phrases of condemnation, the technical argument advanced cannot be taken seriously. The more general charge concerning the limitations of the storage battery due to its very nature, may, however, be noticed. As to these limitations, none probably is more aware of them than advocates of the electric vehicle. But their point of view is that if the limitations do not apply to its profitable use in such work, they have not much more than academic interest—a stand, it may be remarked, which does not differ from that taken with respect to any other matter in this world. That the storage battery can be profitably applied to electric automobiles is no longer an open question in view of the already extended commercial experience had with it. The matter is thus essentially a commercial one, and is not affected by arguments based upon limitations of the storage battery. That the battery is more delicate than the generator of a steam automobile is a matter of indifference, if it commercially answers the purposes for which it is used. The position of our contemporary is, in fact, what might have been the position of the clock trade had the watch been suddenly introduced and considered to menace the clock industry. Experience long since would have shown that the more delicate nature of the watch mechanism could not militate against its use, any more than such arguments as our contemporary offers can influence adversely the employment of the storage battery for automobile work. During the past six months the demand for electric automobiles in this country would, we are in a position to state, have required 40,000 vehicles to satisfy it. Such a condition as this implies should warn our contemporary that, unless it recognizes the absurdity of its attitude, it may soon be an anachronism in a horseless age.—*Electrical World and Engineer*, October 14, 1899.

The Automobile Magazine

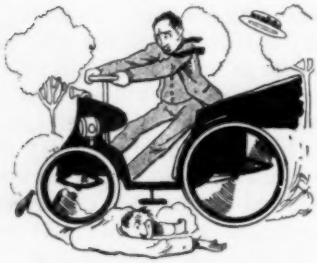
A PUNCTUAL GUEST



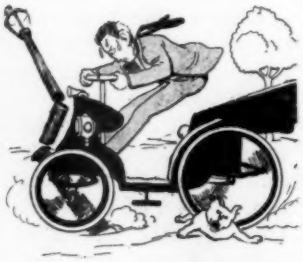
Never mind about instructions.



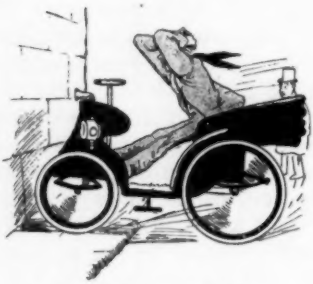
I can run the thing myself.



Whoa! Hold on there!



Will she never stop?



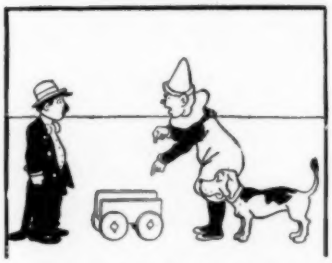
I can see my finish.

Am I in time?

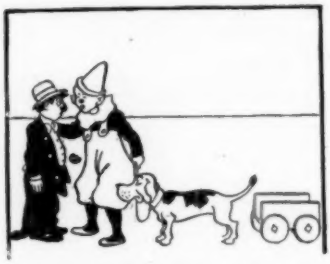
(*Xaudaro in Blanco y Negro.*)

A Practical Demonstration

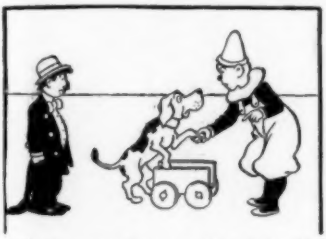
A PRACTICAL DEMONSTRATION



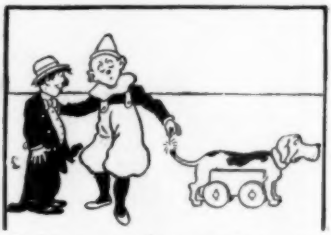
So you don't know what an automobile looks like?



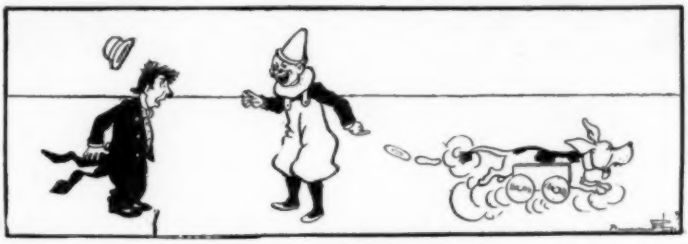
I'll manufacture one right before your eyes.



First you put a motor into the body of the carriage.



If it's a petroleum motor you then light the wick.



And the automobile does the rest.

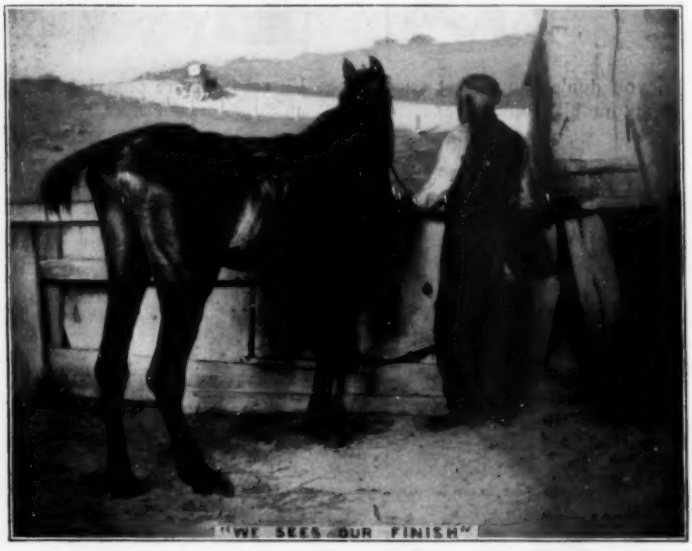
(*Benjamin Rabier in Le Journal Amusant.*)

A PRACTICAL POINT

Scorcher: How would you punctuate, "Look at that pretty girl, in her automobile, spinning down the avenue"?

Putter: That's easy: Comma after "pretty girl" and after "automobile."

Scorcher: I'd rather make a dash after that pretty girl.



IN DIXIE

The old colored man was watching the new-fangled machine spin down the street, and remarked: "I reckens dat mus' be one er—one er dem autographs?"

"It's an automobile."

"Dat's it. I allus was gittin' dem two towns mixed, but I knowed it war some'ere in Alabama."

The New Era

THE NEW ERA

Pedestrian:—I was run down by him as I was crossing the street.

Bike Cop:—Never mind about that. First show me your permit for walking on foot.

(*Benjamin Rabier, in Le Journal Amusant.*)

The Automobile Index

Everything of permanent value published in the technical press of the world devoted to any branch of automobile industry will be found indexed in this department. Whenever it is possible a descriptive summary indicating the character and purpose of the leading articles of current automobile literature will be given, with the titles and dates of the publications.

ACCUMULATORS—

Electrical Laws and Units, by E. C. Rimington. Automotor Journal, London, September 15, 1899.

A Paper by James K. Pumpelly on Storage Batteries. The Autobain, Chicago, September 15, 1899.

Charging and Care of Automobile Batteries. An article on this subject by Mr. Theodore D. Bunce. Scientific American Supplement, New York, October 14, 1899.

ACCUMULATOR TESTS—

A Vibrating Table for Testing Accumulators Described. La Locomotion Automobile, Paris, September 7, 1899.

ACCUMULATORS WEIGHT FOR TRACTION—

A Theoretical Article, illustrated by diagrams, calculating formula for weight of accumulators. By Rosset. L'Industrie Electrique, Paris, September 10, 1899.

ALUMINUM—

Paper read by P. W. Northey at the British Carriage Builders' Convention. "Possibilities and Uses of Aluminum as Applied to Carriage Building." The Autocar, Coventry, September 16, 1899.

An article by Mr. Leon Auscher on the actual uses of aluminum, with various references to its applications into the construction of carriages. Le Chauffeur, Paris, September 25, 1899.

AUTOMOBILE CLUBS—

Organization of American Club commented upon. Automobile Magazine, New York, November, 1899.

AUTOMOBILE COMPETITION—

The International Competition of Heavy Weights (Concours International des Poids Lourds). The official report of the commission upon the exhibits and trials at the competition of the Automobile Club of France in October, 1898; with many illustrations. Three articles, one plate. Génie Civil—July 29; August 5, 12, 1899.

AUTOMOBILE CONTROL—

Description of a method of Control for Automobiles, as per English patent, issued to Henry Leitner, of London. Electrical World and Engineer, New York, September 23, 1899.

AUTOMOBILE EXHIBITION—

Automobile Exhibition at Paris. Editorial on the second exhibition of automobiles held under the auspices of the Automobile Club of France, calling attention to tendencies in the evolution. Engineering, London, July 21, 1899.

AUTOMOBILE FIRE-ENGINE—

A New Automobile Fire-Engine. From La Nature. Illustrates and describes a fire-engine invented by M. Porteu, which has been found to operate most successfully. Scientific American Supplement—August 5, 18, 1899.

AUTOMOBILE FIRE EQUIPMENT—

A short illustrated description of this automobile which has been on trial for four months with good success. The battery has a weight of 520-kg., which is only a fifth of the total, 2,500-kg., including the crew, and a capacity or 150 ampère hours at the rate of 35 ampères. If discharged in 17 hours 48 minutes, or in 7 hours 24 minutes, or in 3 hours 52 minutes, the accumu-

lators give 26.7, or 22.2, or 19.35 ampère hours per kg. of plates respectively, at 1.5, or 3, or 5 ampères respectively, per kg. of plates. It will run 4 to 5 hours at speeds of 15- to 22-km. per hour. —L'Industrie Electrique, August 10, 1899.

AUTOMOBILE FRAMES—

Canello Durkopp's Automobile Frame, described and illustrated. La Locomotion Automobile, Paris, September 7, 1899.

Henriod System, described and illustrated. The Automotor Journal, London, September 15, 1899.

AUTOMOBILE HANSOM—

New Type of French Automobile Hansom, described and illustrated. Electrical World and Engineer, New York, September 16, 1899.

AUTOMOBILE PHAETONS—

Phaetons at the Exposition of the Automobile Club. The first of a series of articles discussing the vehicles exhibited at the recent exposition in Paris. Scientific American Supplement, August 26, 1899.

AUTOMOBILE RACES—

An American Auto Race. Illustrated description of Galesburg race. Automobile Magazine, New York, November, 1899.

AUTOMOBILE TRICYCLE—

Detailed Description, with illustrations, of Sangster's English Patent. The Cycling Gazette, Cleveland, O., September 21, 1899.

BEARINGS—

Axle Bearings. Described and illustrated by M. F. Hill. Automobile Magazine, New York, November, 1899.

BRAKE—

Illustrated Description of A. Bollée's Band Brake. Le Chauffeur, Paris, September 25, 1899.

CARBURETERS—

Starr & Gogswell Closing Carbureter, described and illustrated. La Locomotion Automobile, Paris, September 7, 1899.

L. Aster's Carbureter, with an automatic regulator, described and illustrated. La France Automobile, Paris, September 10, 1899.

Carbureter de Sales, described and illustrated. Le Chauffeur, Paris, September 11, 1899.

De Sales & Braly's System, described and illustrated. Automotor Journal, London, September 15, 1899.

Kellett's System, described and illustrated. The Automotor Journal, London, September 15, 1899.

CHARGING HYDRANT—

Suggestions for a Charging Hydrant, with illustrations. Motor Vehicle Review, Cleveland, October 3, 1899.

COMPARISON OF AUTOMOBILES—

An article, with many illustrations of American, French, and English automobiles, discussing the relative advantages of electricity, gasoline, and steam-power for automobiles. The electrical system is claimed to be the best on account of the simplicity of operation and its availability for private carriages and delivery wagons, provided the distances are not more than thirty miles over ordinary grades at an average speed of eleven miles an hour, which represents one discharge of the battery, and provided the load to be carried by delivery wagons is under 1,000 lbs. The other motive powers are better able to fulfil the requirements of greater distances and heavier loads. Cassier's Magazine, New York, September, 1899.

COMPETITION, RULES AND REGULATIONS—

Rules and Regulations Governing Trial Tests for Heavy-Weight Automobile Vehicles, organized by the Automobile Club of France. La Locomotion Automobile, Paris, August 31, 1899.

CONTROL OF ELECTRIC VEHICLES—

A Paper by E. H. Cozens Hardy, indicating the methods employed to start, run, and stop electric automobiles; serial. The Automotor Journal, London, July 15, and September 15, 1899.

DOUBLE MOTOR AUTOMOBILE—
Double Motor Automobile, described and illustrated. Le Chauffeur, September 11, 1899.

DISTRIBUTOR—
Henriod Distributor, replacing the carbureter, described and illustrated. The Automotor Journal, London, September 15, 1899.

EARLY AUTOMOBILES—
First American Automobile, described and illustrated. Automobile Magazine, New York, November, 1899.

The First Motor Ride, Sir G. Gurney's Steam Stage-Coach. Described and illustrated by J. G. Carteret. Automobile Magazine, New York, November, 1899.

ELECTRICAL MEASUREMENT—
Fundamental Facts in Connection with the Problem of How Electrical Quantities are Measured. The Automotor Journal, London, September 15, 1899.

ELECTRIC AUTOMOBILES—
The Monnard Electromobile. Translation of an article by M. Delaselle in La Locomotion Automobile. Description, with several illustrations. Automotor Journal, August, 1899.

A Paper on Electric Automobiles and their Limitations. The Horseless Age, New York, September 27, 1899.

The Chapman Electromobile, described and illustrated. Scientific American, New York, September 30, 1899.

Riker's Electric Truck, described and illustrated. Electrical World and Engineer, New York, October 7, 1899.

Automobile Street Sweeper and Sprinkler, described and illustrated. Scientific American, New York, October 7, 1899.

Electric Break of the American Electric Vehicle Company described and illustrated. Electrical World and Engineer, New York, October 7, 1899.

Riker's Electric Demi-Coach, described and illustrated. Scientific American, New York, October 14, 1899.

Polemic Discussion. Electrical World and Engineer, October 14, 1899.

Monograph by Professor Felix Michotte. Automobile Magazine, New York, November, 1899.

ELECTRIC IGNITER—
Ignition by Dry Batteries. Automobile Magazine, New York, November, 1899.

FIRST AUTOMOBILE—
L'Ouest Sportif claims that the first automobile was constructed in Nantes in 1864. La Locomotion Automobile, Paris, September 7, 1899.

FRENCH REGULATIONS—
Automobile Regulations in France. A review of the new French regulations governing the use and sale of self-propelled vehicles of every type. Engineering Record, August 12, 1899.

HUB—
A Rubber-packed Hub for Automobile Wheels described. La Locomotion Automobile, Paris, August 31, 1899.

HYDRO-CARBON AUTOMOBILES—
Vehicles of the Société Bourguignonne, described and illustrated. La Locomotion Automobile, Paris, August 31, 1899.

Canello Dürkopp's Phaeton, described and illustrated. La Locomotion Automobile, Paris, September 7, 1899.

Calloch System, described and illustrated. La France Automobile, Paris, September 10, 1899.

Léon Bollée's Voiturette, described and illustrated. Le Chauffeur, Paris, September 11, 1899.

Léon Bollée's Vehicle, described and illustrated. Le Chauffeur, Paris, September 11, 1899.

Vallée's New Vehicle, described and illustrated. La Locomotion Automobile, Paris, September 14, 1899.

Description and Illustration of a Daimler Vehicle built for the Duke of Westminster. The Auto-

motor Journal, London, September 15, 1899.

The De Py System, described and illustrated. Automobile Magazine, New York, November, 1899.

Fritcher-Houdry System, described and illustrated. Automobile Magazine, New York, November, 1899.

HYDRO-CARBON MOTOR BICYCLE—

I. Hughes' & W. Owens' Patent, described and illustrated. The Automotor Journal, London, September 15, 1899.

HYDRO-CARBON MOTOR REGULATOR—

Canello Dürkopp's Motor Regulator, described and illustrated. La Locomotion Automobile, Paris, September 7, 1899.

HYDRO-CARBON MOTORS—

Trotler's Two-Cycle Motor, described and illustrated. La Locomotion Automobile, Paris, August 31, 1899.

The Bolide Motor and Mechanism. Illustrated description. The Automotor Journal, London, August, 1899.

Canello Dürkopp Motor, described and illustrated. La Locomotion Automobile, Paris, September 7, 1899.

Description of the Calloch Motor. La France Automobile, Paris, September 10, 1899.

Marius Marmonier's New Motor, described and illustrated. La Locomotion Automobile, Paris, September 14, 1899, also L'Industrie Automobile, Paris, September 25, 1899.

Henriod Motor, described and illustrated. The Automotor Journal, London, September 15, 1899.

Doré's Motor, described and illustrated. Automobile Magazine, New York, November, 1899.

Daimler's System, described and illustrated. Automobile Magazine, New York, November, 1899.

HYDRO-CARBON TRICYCLES—

Simms Tricycle, with two front driving-wheels, described and illustrated. La Locomotion Automobile, Paris, September 28, 1899.

LIQUID AIR—

An article by Frank Richards, on possible methods of applying liquid air to automobiles. Compressed Air, New York, October, 1899.

LIQUID FUEL BURNER—

Musker's Automatic Liquid Fuel Burner for Heavy Motor Vehicles, described and illustrated. The Automotor Journal, London, September 15, 1899.

LUBRICATORS—

Despont & Godfroy's Sight Feed Lubricator, described and illustrated. Automobile Magazine, New York, November, 1899.

MILITARY AUTOMOBILES—

Illustrated Description of the Function of the Automobile in War, by Edwin Emerson, Jr. Automobile Magazine, New York, November, 1899.

MOTOR-COOLER—

Automizer used as a Motor-Cooling Device, described and illustrated. La Locomotion Automobile, Paris, August 31, 1899.

Water Coolers, Julian System, described and illustrated. Automobile Magazine, New York, November, 1899.

POWER TRANSMISSION—

A New Power Transmitter and Speed Changer, described and illustrated. Automobile Magazine, New York, November, 1899.

PUMPS—

Dalligol & Thomas Water Circulating Pump Described. Automobile Magazine, New York, November, 1899.

RECONDENSATION OF STEAM IN STEAM MOTOR VEHICLES—

An article by Mr. Hudson Maxim on his invention for the recondensation of steam. Horseless Age, New York, October 11, 1899.

REDUCING GEAR—

Humpage New System of Reducing Gear, as applied to electric motors, described and illustrated. Electrical World and Engineer, New York, September 23, 1899.

SPEED VARYING GEAR—

Canello Dürkopp's System, described and illustrated. La Locomotion Automobile, Paris, September 7, 1899.

Henriod System, described and illustrated. The Automotor Journal, London, September 15, 1899.

STEAM AUTOMOBILES—

Brown-Whitney Steam Automobile, described and illustrated. The Autocar, London, September 9, 1899.

Description of the Stanley Steam Vehicle. The Autocar, Coventry, September 16, 1899.

STEAM-BOILER—

Tower & Company's Boiler for Steam Automobiles, described. La Locomotion Automobile, Paris, September 7, 1899.

STEAM MOTOR—

Jaquemin Patent, producing directly the circular motion in steam-engines, described and illustrated. La France Automobile, Paris, September 10, 1899.

STEEL TUBING—

Their use in automobiles, by C. G. Canfield. Automobile Magazine, New York, November, 1899.

STEERING—

The Steering of Automobiles With Divided Axles (Du Virage des Automobiles à Essieux Brisés). D. Dujon. An analysis of the action of independently adjustable steering wheels, showing the method adopted for the prevention of slippage on short turns. Revue Technique, Paris, August 10, 1899.

STEERING AXLES—

A Series of Articles on Steering Vehicles by Divided Axletree. La Locomotion Automobile, Paris, September 21, 1899.

STEERING GEAR—

Canello Dürkopp's System, described and illustrated. La Locomotion Automobile, Paris, September 7, 1899.

Priestmann & Wright's Steering Gear, described and illustrated. The Automobile Magazine, New York, October, 1899.

STEERING MECHANISM—

Henriod System, described and illustrated. The Automotor Journal, London, September 15, 1899.

SWITCH AND CONTROLLER FOR ELECTROMOTORS—

Elieson's Patent, described and illustrated. The Automotor Journal, London, September 15, 1899.

TIRES—

Description of a New Tire, which is a combination of the pneumatic, the cushion, and the sponge types. The Cycling West, San Francisco and Denver, October 5, 1899.

Julian Tire, described and illustrated. Automobile Magazine, New York, November, 1899.

TRIAL TESTS—

Project of an Automobile Race from Paris to St. Petersburg. La Locomotion Automobile, Paris, September 7, 1899.

French Trials of Electric Delivery Wagons. Electrical World and Engineer, New York, September 23, 1899.

The Paris Cab Trials. Translated from Le Génie Civil. An account of the June trials, with description of the vehicles. Automotor Journal, August, 1899.

The Agricultural Hall Exhibition Efficiency Trials. Gives complete results of these trials. Automotor Journal, August, 1899.

The Liverpool Heavy Motor Vehicle Trials. A full account of the trials, with illustrated description of the vehicles. Automotor Journal, August, 1899.

The Liverpool Motor-Wagon Trials. Brief account of the second annual series of trials of motor-vehicles for heavy traffic. Describes vehicles and tests. Transport, August 4, 1899.

VALVE GEAR—

Henriod System, described and illustrated. The Automotor Journal, London, September 15, 1899.

WAGGONETTE—

Burns "Endurance" Waggonette, described and illustrated. The Autocar, September 9, 1899.